ARCHIVES OF OPHTHALMOLOGY.

CLINICAL ASPECTS OF OCULAR TUBERCULOSIS.[1]

By DR. W. H. WILMER, BALTIMORE, MD.

(With two illustrations in color on Text-Plates I. and II.)

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THE literature on ocular tuberculosis has recently been reviewed by Clapp (1), who states that tuberculosis of the eye was described as early as 1816.

In 1855 Von Graefe (2) reported a case of tuberculous chorioiditis in swine. He states: "The macroscopic and the microscopic examination left no doubt of the tuberculous nature of the exudative process," and further, that "if there is a description of tuberculosis of the chorioid in man, it is not definitely known." He suggests, however, that certain chorioidal exudates observed in children might be tuberculous. In 1857 Manz (3) published a case of acute miliary tuberculosis in which the nodules found in the chorioid were of the same character as those found in other portions of the body. Bergmeister (4) states that Horner, in 1879, was the first to describe the ophthalmoscopic appearance of a solitary tubercle of the chorioid. It appeared as a gray, regular lump surrounded by a bright irregular border, and a fibrous exudate.

But it is only within the last quarter of a century that ocular

[1] From the Wilmer Ophthalmological Institute, Johns Hopkins University.

tuberculosis has received the attention it deserves. During this period a great change has taken place in the attitude of ophthalmologists towards the causes of the various inflammations of the highly differentiated tissues of the eye. Twenty-five years ago writers believed these lesions were due to syphilis, gout, rheumatism, or were "idiopathic." "Idiopathic" was a current term to cover our ignorance of the cause, and no doubt under this term were included many cases in which tuberculosis was the real origin of the disease.

In 1923, at the meeting of the American Ophthalmological Society, Finnoff (5) exhibited rabbits in which he had produced lesions of the fundus in some instances by the injection of living tubercle bacilli in the common carotid artery, and in other instances by the injection of the dead tubercle bacilli. In closing the discussion he confirmed Stock's conclusion that tuberculosis could involve every tissue of the eye except the lens. (I may add, parenthetically, that indirectly it often involves the lens by interfering with its nutrition.) Finnoff also made the statement that "tuberculosis of the eye in humans is undoubtedly a rare disease." Living in Denver, where pulmonary tuberculosis is common, his statement agrees with the general experience of many tuberculographers; *i.e.*, that it is comparatively rare to have tuberculous eye lesions in pulmonary tuberculosis patients. Later Finnoff stated: "It is true that we see ocular tuberculosis rarely in generalized tuberculosis, because these cases, when they do occur, go rapidly and necessitate enucleation."

In March 1926, Meller (6), of Vienna, writes that tuberculosis is a very much more important cause of iridocyclitis than is ordinarily thought. He comes to the conclusion that, in ordinary cases, there can be no certainty as to the exact situation of the primary lesion. He maintains, however, that a practical proof of the nature of the infection can be obtained by the therapeutic use of tuberculin; so much so, that in his clinic, tuberculin injections have become a regular method of treating chronic iridocyclitis, and only in those cases where it fails, are other methods tried. Meller regards the severe focal reaction—a danger attending the use of tuberculin—as a definite proof of the tuberculous nature of the infection.

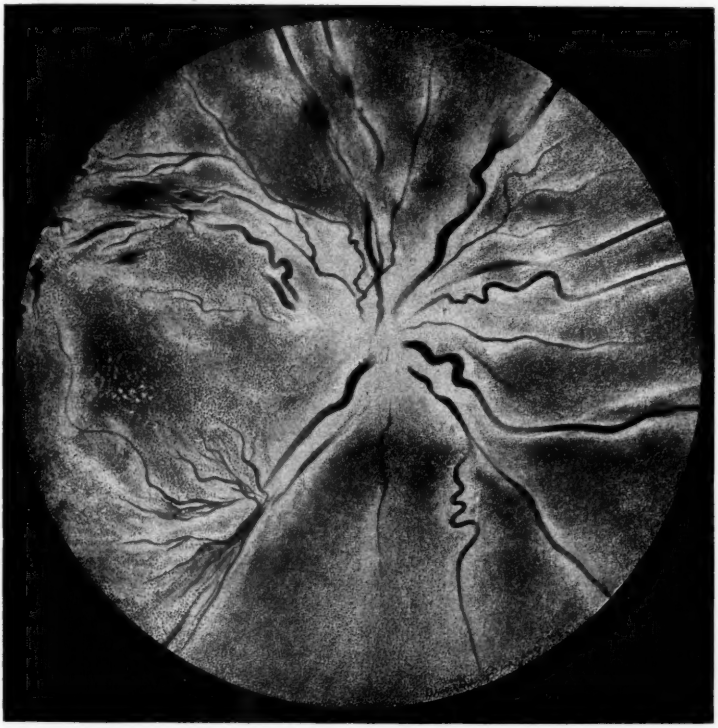
ILLUSTRATING DR. WILMER'S ARTICLE ON "OCULAR TUBERCULOSIS."

CASE III.

Circumscribed chorioiditis in macular region with hemorrhage in retina, tuberculous.

UNIV. OF MICH.

ILLUSTRATING DR. WILMER'S ARTICLE ON "OCULAR TUBERCULOSIS."



CASE II.

Extensive chorio-retinitis in young negro, tuberculous.

UNIV. OF MICH.

In a recent article, Lōwenstein (7) states that a great number of chorioretinal diseases, the etiology of which remained obscure for many years, are now ascribed to tuberculosis. The tubercle bacillus finds its way into the blood circulation, and has a special predilection for the walls of the blood vessels. The chorioid, with its rich vascularization, especially the fine network of the chorio-capillaries, is a very favorable field for the establishment of the tubercle bacillus. This explains the frequency of the tuberculous chorioidal affections. Lōwenstein notes that chronic tuberculosis of the chorioid is very seldom associated with tuberculosis of the lungs. He is of the opinion that while the primary lesion may be in the lungs, it is already healed at the time of the secondary tuberculous infection of the eye. Mild local disease which progresses to healing does not produce an immunity for other organs; while a severe local affection may produce a general immunity, protecting more remote organs from the disease.

Neufeld (8) has shown that the reason various bacterial diseases may become chronic and resistant is the fact that the causative bacteria have become atoxic; and therefore the patient's resistance is not strengthened by the formation of antibodies.

Luedde (9) has suggested that the eye lesion might be due to a transference of the bacilli from the naso-pharynx through the lymphatics. Many observers have suggested the possibility that the eye lesion might result from fibrosed or calcified mediastinal glands.

In 1926 at the meeting of the American Ophthalmological Society, Verhoeff (10) said: "Now if there is any one thing of which I am sure, it is that ordinary scleritis and keratitis, that is to say, anterior nodular scleritis, are always due to tuberculosis." Derby (10) agreed with him entirely, and said later on in the discussion that "if you analyze the American literature, tuberculosis is perhaps given as the cause of uveitis or diseases of the uveal tract in 10 per cent. or less of cases. Whereas, if you take the German literature, you will find figures running to 50 per cent. and upward. Probably their figures are much too high; certainly ours are much too low." My experience agrees very closely with Derby's. But while I feel that tuberculosis is the most common cause of

scleritis, I have seen a few cases that were caused by either sinus infection or gout.

Wolff-Eisner (11) quotes Groenow in saying that one case of tuberculosis of the eye occurs in 4,600 ophthalmic patients; Herrier, one in 4,000 (and especially refers to tuberculosis of the iris); Stephenson one in 1,500 (conjunctival tuberculosis being the most frequent). Milburn finds one case of tuberculosis of the eye in every 200 ophthalmic patients, and believes that it occurs more frequently.

Greear (12) records a careful examination of the fundus in twelve cases of children with tuberculous meningitis. Tubercles were found in the chorioid in only one instance.

Robin and Lesbouyéres (13) have stated that they have found a tendency towards tuberculous diseases of the eye in cats, and that tubercle bacilli were found in these cases.

Jackson (14) says: "A tuberculous focus can exist in the body quiescent but quite able to originate active disease for an average life time." In speaking of tubercles of the chorioid he says: "In the last few days of life they appear very frequently (over fifty per cent.) in the active tuberculosis of children and young people."

During the past ten years there has been much discussion concerning the frequency of tuberculous eye lesions; the mode of infection; the relation to general and pulmonary tuberculosis; the use of tuberculin diagnostically and therapeutically, and its value over foreign proteins. Some have even questioned whether the clinical course of these eye lesions is more favorable under the use of tuberculin than it has been under the use of iodides and mercury. While some of my colleagues start with a diagnostic dose of 0.5*mgm* of tuberculin, others hesitate to use even the most minute amount. It is upon these points that I will particularly dwell.

Hamman (15), in speaking of the great frequency of tuberculous eye infections, says "this is not strange when one considers that 95% of all adults are infected with tuberculosis."

It is certain from the extensive literature on the subject that every portion of the eye and its adnexa may be the seat of tuberculosis. The percentage of ocular tuberculosis reported varies greatly with the social status of the cases

from which the statistics are taken; the tissue of the eye involved; whether the disease is acute or chronic; the precautions in excluding other sources of infection; and the method of using tuberculin in diagnosis, etc.

My statistics would be very misleading, if I did not state at the beginning that the patients I have had under observation in the hospital have usually passed beyond the early and acute stages of the disease; the conditions have been resistant to the usual therapeutic measures; the eyes have been severely damaged; and syphilis and focal infections have been excluded as far as possible.

The analysis of a group of cases under my observation before I came to Baltimore, shows that tuberculosis was the cause of the uveal inflammation in 40% of the cases. In the last eighteen months, tuberculosis has been the cause in 42% in a group of cases of chorioretinitis, and in 44% in a series of chorioiditis.

The diagnosis of tuberculosis as the etiological factor in ocular disease has been reached only after a complete diagnostic study where other possible factors have been eliminated, and in which a high degree of tuberculin hypersensitivity has been demonstrated. The diagnostic study now used in the Wilmer Institute of the Johns Hopkins Hospital, is as follows: Nose and throat; dentistry; X-ray of sinuses; X-ray of chest; X-ray of gall bladder; X-ray of G. I. tract; basal metabolism; blood chemistry, including blood sugar, blood non-protein nitrogen, blood uric acid and blood calcium; blood pressure; urine; stool; kidney function (phthalein); intradermal tuberculin; hæmocytology; hæmoglobin; clotting time; Wassermann; general physical examination; gynecological or genito-urinary examination.

There are three types of tuberculous intra-ocular inflammations of which I wish to speak. The first is uveitis characterized by the following symptoms: varying intraocular tension; mutton fat deposits upon the posterior surface of the cornea; sometimes posterior synechiæ; exudation upon the anterior capsule of the lens in the more severe cases; vitreous opacities; disseminated chorioretinitis or chorioiditis circumscribed in the macular region. In this type of uveal inflammation there may be no other recognizable tuberculous focus.

But in some cases it is associated with tuberculous foci in other parts of the body. This group is illustrated by the following cases:

CASE I.—B. C., Miss. Age: 23 years, Ht. 5′ 1½″, Wt. 106 lbs. Admitted December 27, 1926.

Complaint.—Gradual loss of vision L. E.

Family History.—Negative.

Past History.—At age of 12 years, injured right leg. Septicemia followed. Osteomyelitis, recurrent, last 11 years. 19 operations. 1 year ago severe headaches left side of head.

Present Illness.—In December a similar pain occurred on the left side of head, at which time patient discovered she could not see with the left eye.

Present examination.—Showed chronically infected tonsils and albuminuria. B. P. $\frac{100}{70}$. Intradermal tuberculin test was positive ($\frac{1}{100}mgm$). R.E.V. = $\frac{20}{15}$ L.E.V. = $\frac{3}{70}$.

Ophthalmoscopic examination.—R. E. Normal. L. E. Posterior corneal deposits; many opacities in vitreous. The entire fundus was blurred and indistinct. Massive yellowish-white exudates were present in the macular region with pigmentation on temporal side.

Diagnosis.—L. E. Uveitis (tuberculous) with massive exudation in chorioid.

Treatment.—Tuberculin injections were begun 1/5/27, with a primary dose of $\frac{1}{1.000.000}mgm$. Treatments were given three times a week, gradually increasing the dose. Last dose on discharge, 2/11/27, $\frac{1}{10.000}mgm$.

Discharge note.—February 12, 1927: R.E.V. = $\frac{20}{15}$; L.E.V. = $\frac{5}{100}$. Patient was instructed to continue tuberculin treatment and to have tonsils removed.

Under tuberculin K.P. deposits disappeared within four weeks. Last eye examination was three months after inauguration of treatment and showed L.E.V. = $\frac{10}{100}$.

CASE II. (ILLUSTRATION I)—J. C. (Colored), Age: 16 years. Ht. 5′ 5½″, Wt. 131¼ lbs. Admitted to hospital January 30, 1926.

Complaint.—Poor vision both eyes. Gradual loss of vision began in November 1925. Frequent headaches. Difficulty in counting fingers at 2 feet.

Examination showed the following positive findings: Bilateral tuberculous epididymitis. Old tuberculous infection both lungs. Spinal fluid 16 cells. Spinal Wassermann negative. Intradermal tuberculin test positive ($\frac{1}{1.000}mgm$). Remains of old infection left antrum. Basal metabolism −3.0. W.B.C. 8,200. Average pulse 64. B.P. $\frac{132}{78}$.

R.E.V. = $\frac{6}{60}$. L.E.V. = $\frac{6}{60}$.

Ophthalmoscopic examination.—Showed numerous vitreous opacities. In each eye the fundus was somewhat blurred, the entire nerve heads were illy defined and so engorged that it almost suggested papilledema. Massive exudation over the whole fundus. Vessels very tortuous, veins much enlarged, with thrombosis of arteries and veins. Rupture of vessels and hemorrhages. New blood vessels had formed around the occluded vessels, showing the attempt at collateral circulation. Near the macular region were a few minute spots, whitish-yellow, similar in appearance to minute tubercles.

Diagnosis.—Bilateral uveitis: Massive exudation into chorioid and retina (tuberculous); vessel thrombosis; hemorrhages.

Treatment.—Local treatment of eyes, hot applications. Tuberculin therapy. Under tuberculin the spots near the macula disappeared entirely, and there was great improvement in the extensive exudation.

Discharge note.—April 23, 1926: Visual fields practically twice as large as on admission. R.E.V. = $\frac{6}{60}$, L.E.V. = $\frac{6}{60}$, Wt. 142¼ lbs.

Tuberculin treatment was continued after discharge. Improvement has continued.

In the second group of cases the lesion is confined mostly to the posterior segment of the uveal tract; the cornea and iris are not visibly involved; the vitreous is free from opacities, or, at most, they are fine and dust-like; but the local inflammation makes up in severity for the escape of the anterior portion of the eye. There is usually a large yellowish-white exudate with spots of older inflammation, the older spots being slightly pigmented. The exudate itself is surrounded by retinal hemorrhages. This appearance is the result of hyperemia, edema, cellular infiltration, rupture of fine blood vessels, and the formation of fibrous tissue. In the eye first involved, where the vision is usually seriously impaired, there is often a white fibrous mass, with no signs of active inflammation or recent hemorrhages—illustrating Nature's attempt to shut off the bacilli and their toxins by fibrous tissue, but too late to save the eye. This is the type of eye in which a large dose of tuberculin for diagnosis or for cure might be disastrous. Occasionally the massive exudation is so great that the

condition simulates a malignant growth. This type is illustrated by the following case. I am indebted to my friend, Dr. Emory Hill, for seeing this patient.

CASE III. (ILLUSTRATION II)—A. L. A. Age: 40 years. Ht. 5′ 8″. Wt. 143½ lbs. Admitted to hospital October 18, 1926.

Complaint.—Unable to read with L.E. for one year, R.E. three months.

Family history.—Negative.

Past history.—Erysipelas face and head 11 years ago. Tonsils removed June 1926. Pyorrhea: all teeth out. Deflected septum. Severe pain under right shoulder past ten years. Has always been nervous: twitching of eyelids, muscles of neck, shoulders.

Present illness.—Gradual loss of vision L.E. for one year. Vision R.E. began to fail six months ago. Teeth and tonsils removed, but with increased eye symptoms.

Present examination.—Old fibrosis in apices both lungs. Basal metabolism −21.5. Phthalein 50% in two hours. Uric acid 4.1. Intradermal tuberculin test positive ($\frac{1}{10,000}$ *mgm*).

Diagnosis.—R.E. Chorioretinitis, hemorrhagic; L.E. chorioretinitis, atrophic stage (tuberculous).

Treatment.—Hot applications, boric acid irrigations, dionin, thyroid extract, tuberculin therapy.

Discharge.—October 27, 1926. R.E.V. = $\frac{20}{70}$, L.E.V. = $\frac{20}{200}$. To continue tuberculin thereapy. Out door life. Diet. Exercise. Thyroid extract. Reported much improved.

The third type of cases is of great human interest—youthful subjects with recurrent hemorrhages into the vitreous. For the past ten years, in every case of this kind save one, where I have been able to make a thorough survey, I have found the process to be tuberculous. In this one exception there was no reaction to the subcutaneous injection of 5 *mgm* of O.T. and the eyes recovered after the removal of the tonsils. In each of the other cases one or both eyes were saved with useful vision. In these patients where the vision of one eye was severely impaired, the loss of sight was due to very extensive and repeated hemorrhages into the vitreous with the subsequent formation of fibrous tissue, retinitis proliferans.

CASE IV.—H. S. Age: 24 years. First seen May 5, 1921.
Complaint.—Inability to see with either eye.
Family history.—Negative.
Past history.—Diphtheria at age of 11 years. Typhoid fever 1919. Acne 1921. Tonsils removed 1921. Operation for hammer toe 1924.
Present illness.—March 1921 "flu." Hemorrhages found in R.E. One month later hemorrhages found in L.E. Two infected teeth removed.
Present examination.—Subcutaneous tuberculin test strongly positive. B. P. $\frac{108}{76}$. Average pulse 76. Average temperature 97.8. R.E.V. = H.M. L.E.V. = $\frac{1}{200}$. Fundus not visible in either eye, merely gray reflex seen. Vitreous filled with blood.
Diagnosis.—Recurrent hemorrhages into vitreous, with resulting retinitis proliferans, both eyes (tuberculous). Cataract, complicated, right eye.
Treatment.—Tuberculin, hot applications, dionin. April 26, 1926, R.E.V. = 0, L.E.V. = $\frac{10}{60+1}$. Reads Jaeger 1 at 6″ with ease. Eyes are entirely quiet. General health perfect. No intraocular hemorrhages for four years.

CASE V.—J. B. W. Age: 32 years, height 5′9″, weight 166½ lbs. First seen December 3, 1920; readmitted January 27, 1927.
Complaint.—Loss of vision L.E. Beginning loss of vision R.E.
Family history.—Negative.
Past history.—Wassermann negative. Infected tonsils removed.
Present illness.—History of hemorrhages in left eye in 1915, 1917, 1919, 1920. Tuberculin used in 1920. Hemorrhages in right eye 1921 and 1926.
Present examination.—Tuberculin positive ($\frac{1}{10,000}$*mgm*). Basal metabolism − 8.0. Chronic sclerosis both mastoids. W.B.C. 7,600. Blood calcium 12*mgm*. Average temperature 98.2. Average pulse 60. B. P. $\frac{112}{70}$.
Diagnosis.—Hemorrhages into vitreous, R.E. L.E. Hemorrhages into vitreous with retinitis proliferans.
Treatment.—Tuberculin injections.
Discharge.—February 26, 1927. R.E.V. = $\frac{10}{10}$, L.E.V. = $\frac{1}{200}$. Hemorrhages in right eye practically gone. Wt. 175 lbs. To continue tuberculin therapy.

CASE VI.—L. B. Age: 37 years. Admitted to hospital, October 27, 1926.
Complaint.—Loss of sight.
Family history.—Negative.

Past history.—Negative.

Present illness.—History of repeated hemorrhages, first one eye and then the other over a period of three years. Had been told case was hopeless; that nothing could be done for him.

Present examination.—Basal metabolism − 21.0. Chronic infection tonsils and adenoids. Intradermal tuberculin test positive ($\frac{1}{10.000}$*mgm*). Blood calcium 8.86*mgm*. W.B.C. 8,400. Average temperature 98. Average pulse 80 B.P. $\frac{120}{70}$.

R.E.V. = Pl. L.E.V. = $\frac{20}{100-1}$.

Fundus, each eye, loss of red reflex.

Diagnosis.—Bilateral intraocular hemorrhages into vitreous (tuberculous).

Treatment.—Locally, hot applications, dionin, salt injections. Tuberculin therapy. Tonsils to be removed later.

Discharge.—April 28, 1926. Marked improvement. General condition greatly improved. To continue hot applications, dionin and tuberculin.

Extract from letter received January 27, 1927: "I can read the finest type on the optician's hand reading card, the section marked V = .50D.

"I have had several afternoons by the sea, though I have not yet tried to swim the Catalina Channel! Last Sunday I did some climbing, stopping to rest when it seemed that I was pumping too hard, and finally got to a peak perhaps 1500 feet above sea-level, from which we had started. I have perceived no ill effects from the climb or the brightness of the sun. I am going to try a little dancing this evening. My general health has been excellent, and my appetite enormous. I still weigh about 155, but hope to wear off a few pounds safely.

"It had been announced that I had not one chance in a thousand of saving my sight. The by-standers are duly impressed when they see me seeing."

Comment.

Mode of Infection.—In the case of external diseases of the eye the process may be primary, but in the deeper structures it is metastatic, through the blood stream from some quiescent focus in the lungs or glands. Sometimes traumatism may have some influence in starting up the process.

Relation to General Tuberculosis.—The eye lesions, where there are no other recognizable tuberculous conditions, seem

to be due to bacilli of a milder strain. Therefore there is little tendency to total destruction of the eye; but these less toxic bacilli fail to stimulate the formation of antibodies and cell activity. Therefore, the eye lesions show very little tendency to spontaneous recovery; but they do react favorably to the artificial use of tuberculin in proper doses. On the contrary, where the eye is involved in general tuberculosis, the affecting bacilli are of a more virulent strain; the delicate tissues of the eye quickly succumb, and the eye undergoes the same disastrous pathological changes observed in the lungs—confluent tubercle and caseation. This may answer the question: "Why does tuberculin act so remarkably well in ocular tuberculosis, when the eye alone is involved, and is of so little value in general tuberculosis?"

Diagnostic Use of Tuberculin.—Jackson (14) states that "tuberculin is not wholly reliable, but such tests do throw an important light on the case."

Zinsser and Tamiya (16) state: "We have preferred to confine our studies chiefly to skin reaction. This is, of course, not absolutely dependable, since responses of the skin need not run parallel to general hypersusceptibility. But accumulating clinical evidence seems to indicate that such a parallelism is fairly close, and if we remember possible divergence under special circumstances, this method need not lead us into error."

Danysz (17) says that "experience has shown that tuberculin secreted by a tuberculous focus penetrates throughout the organism and that it provokes immunizing reactions in every tissue, especially those of ectodermal origin." The same author states: "But we know that a dose of tuberculin known to be harmless for the normal organism, or even a much smaller dose, will provoke in a tuberculous patient a general reaction more or less severe when injected under the skin. . . ."

Head (18) states: "I first began the use of Koch's old tuberculin subcutaneously, for diagnostic purposes, in the year 1895. Since that time I have tested more than one thousand persons suspected of harboring either pulmonary, pleural, glandular, peritoneal, bone or joint tuberculosis in so insidious a form as to require a specific test to establish the diagnosis. . . I wish to state here that from a large

experience extending over many years, with abundant opportunity to watch patients so tested from year to year, I have never observed any evidence to prove that tuberculosis was disseminated by the use of tuberculin subcutaneously, but, on the other hand, have a firm conviction that this diagnostic test with a good reaction has a healing effect upon the lesion in its insidious and low-grade forms."

Hamman (15) says, "If it is found that the patient reacts markedly to intradermal injections of extremely minute doses of tuberculin the presumption that there is some activity in the tuberculous infection of the patient is strengthened and with some reservations we may feel a greater certainty that the ocular trouble is of tuberculous origin."

My limited experience conforms to that of other observers of wider knowledge that the patient who does not have a tuberculous focus is practically invulnerable to ordinary amounts of tuberculin. But when the contrary state exists, the patient's tissues, including the skin, are sensitive to a minute amount. I have seen a very extreme general and local, and disastrous focal reaction to 0.50*mgm* of O.T. injected under the skin in a suspected tuberculous subject, and no reaction whatever to 5.0*mgm* in a person where it was necessary to quickly exclude tuberculosis (the case of tonsillar infection before mentioned).

Many observers of experience feel that to obtain a positive diagnosis of tuberculosis, it is necessary to recognize a focal reaction. When the lesions involve the retina and there are hemorrhages, this is a dangerous procedure: it would give very positive information, but it would risk this delicate structure to damage beyond repair. Such information is entirely too costly—"like following life through creatures you dissect, you lose it the moment you detect." In the case of external diseases, it is another matter: the same danger does not exist. The logical and safe method is to use the patient's skin as a test of his hypersusceptibility to tuberculin.

In the inflammations of the deeper structures of the eye, it is obvious that we cannot prove the correctness of the diagnosis by the microscope, or by animal inoculation. In regard to this question Jackson (14) makes the following interesting statement: "In the laboratory the finding of

the tubercle bacillus is always positive evidence of tuberculosis; but the failure to find it does not prove that the lesion is not tuberculous. This is especially true of tuberculous lesions in and about the eye. In tuberculosis of the conjunctiva the bacilli are few and may not be found at all. In deeper structures no tissue can be obtained for histological examination. Probably, too, the apparent absence of bacilli from the tissues is often due to the fact that they do not take the Ziehl stain. Meader showed that this was the case where the bacillus was relatively less virulent."

Complement fixation is not yet sufficiently stable to be reliable, but it is worthy of much serious study.

In making the intradermal test for diagnosis,[1] the anterior surface of the forearm is sterilized. $\frac{1}{10}cc$ of glycerin broth is injected intradermally as a control. $\frac{1}{10.000}$ of a milligram of old tuberculin is then injected intradermally about $10cm$ from the control. The patient is then observed for 48 hours, temperature, pulse and respiration being recorded every four hours. Any local, focal or general reaction is recorded in the history, the local reaction being recorded in the form of a sketch. If there is no reaction after 48 hours, a second injection with its control is made, using $\frac{1}{1.000}$ of a milligram. If this is negative a third injection of $\frac{1}{100}$ of a milligram is used and then $\frac{1}{10}$ of a milligram. The dose is carried as high as 1 milligram in cases where no contra-indication exists. A tuberculin syringe is always used for the diagnostic administration of tuberculin.

Therapeutic Use of Tuberculin.—In regard to the therapeutic use of tuberculin, Danysz (17) says: "From the total of the theories which we have just reviewed we are forced to conclude that in tuberculosis it may not only be a question of an immunity from antituberculin but since it is shown that tuberculosis can heal spontaneously and that a certain relative immunity may be obtained by bacterial vaccination we should necessarily assume that a bacterial therapy and a specific chemo-therapy should very appreciably aid the destruction of the bacteria. Serum therapy would be applicable only in

[1] In the Wilmer Institute of the Johns Hopkins Hospital the diagnostic and the therapeutic use of tuberculin is in charge of Dr. L. N. Gay.

the stages of the disease during which one could establish the absence in the organism of antibody in excess."

In 1904, Trudeau (19) and his associates published reports of very interesting work upon tuberculin reaction. Their general conclusion was that "In localized corneal tuberculosis of the rabbit eye no spread of the disease in the cornea could be observed after the use of tuberculin injections. On the contrary, as in previous observations, a favorable absorptive influence was noted upon the diseased focus."

In the cases that I have reported it will be seen that tuberculin has exerted a very beneficial influence not only upon the local malady but upon the patients' general health. Unfortunately there is a reverse side of this picture: at times the disease is so extensive that it takes a long time to get it under control, and even then the delicate tissues of the chorioid or the retina have been so seriously injured before the use of tuberculin, or the tubercular mass is too extensive to be materially helped. For instance, I have under treatment today a most obstinate case of uveitis, with massive K. P. deposits on the cornea and secondary glaucoma. After two months' careful treatment the cornea has just become practically clear, the tension is better; but the vision, even now, is only counting fingers at 6″. To start there was only light perception in the temporal field. I feel in this case there is a limit beyond which recovery cannot take place.

I have seen cases where the eye had been enucleated because sarcoma of the chorioid was suspected, but which was not found on microscopic examination. These patients were very sensitive to tuberculin, and with the proper use of it, they might have had a chance of recovery.

In tuberculin therapy, bouillon filtrate (O.T.), or Bacillen Emulsion is used subcutaneously. While under hospital care temperature, pulse and respiration are observed every 4 hours. Any local, focal or general reaction is recorded in the history. We begin with $\frac{1}{1.000.000}$ of a milligram of tuberculin, given twice a week, increasing the dose as follows: $\frac{3}{1.000.000}$ of a milligram, $\frac{3}{1.000.000}$ of a milligram; $\frac{5}{1.000.000}$ of a milligram, $\frac{7}{1.000.000}$ of a milligram, $\frac{9}{1.000.000}$ of a milligram, etc., until a dose of 1 milligram is reached. When the patient can be under personal observation, the dose is increased at

times to as much as 100 milligrams. The effect upon the eye is noticed regularly, and in case of unfavorable reaction, the administration must be stopped until this reaction has disappeared, and then resumed with the dose given before the unfavorable reaction was observed. The usual aseptic precautions are followed.

Foreign Proteins.—I feel sure that foreign proteins, such as milk, are helpful in these cases by assisting local cell activity. But milk is not as potent as tuberculin; does not produce specific antibodies; does not build up the patient's general condition; the dosage is not so easily calculated; and there is always the danger of an added absorptive reaction. In instances where tuberculin has been used with improvement in the eye condition, I have seen a marked focal reaction when milk injections have been added with the hope of accelerating recovery. Apropos of proteins, Arton and Forman (20) say that they have "induced marked skin reactions to injections of various proteins in tuberculous subjects by making tests simultaneously with tuberculin injections."

Relation to other Focal Infections.—A tuberculous focus seems to render the eye more susceptible (or less resistant) to the poison of other infections. It is therefore most important to remove every source of infection, from the teeth, tonsils, sinuses, etc.

Other Aids.—Proper food, outdoor life, sunshine, rest and exercise, are most important. Locally atropine is necessary where the anterior uveal tract is involved. All remedies that determine blood to the eye are helpful, for as Jackson (14) says: "at first there is no inflammatory hyperemia excited, to oppose the process of tubercle formation. . . . It is one of the dangers of tuberculosis that vascular reactions come late." Among these agencies, are hot applications, dionin, and, in external affections, the violet ray, radium, X-ray.

Method of Healing.—In the cases of large exudations in the interior of the eye I have never seen the process heal by resolution; but I have seen minute tubercles in the chorioid and in the iris entirely disappear under the use of tuberculin. My friend, Dr. C. L. Minor, tells me that he has noted the same good result from tuberculin in the case of small tuberculous lymph nodes; and I was interested this morning to see in

your laboratories cases of intestinal tuberculosis where the lesions had healed by resolution without fibrosis.

Conclusions.—Tuberculosis is a very important etiological factor in resistant lesions of every portion of the eye or its surrounding parts.

Tuberculous ocular lesions where no other tuberculous focus is recognizable, may be due to a strain of bacilli less virulent than those which cause general pulmonary tuberculosis. The lesions seem to be due to the presence of bacilli rather than to merely toxins.

This milder type of ocular inflammation is not often associated with a general tuberculous condition.

Tuberculous eye lesions, especially those cases of recurrent vitreous hemorrhages in young people, are often accompanied by evidences of subnormal bodily health—clammy extremities; pasty complexion; low blood pressure, temperature, and basal metabolic rate; slight general leucocytosis; occasionally a lowered blood calcium content; and often general lassitude and depression.

In ocular tuberculosis, the eye tissues seem to be sensitized to other sources of infection; these should be scrupulously removed.

The complement fixation is worthy of further study.

After all sources of infection, except tuberculosis, have been excluded, the intradermal use of O.T. affords a safe and definite method of determining the patient's hypersusceptibility to tuberculin.

If the skin reaction is strongly positive to a minute dose, the assumption of the probability that the eye lesion is tuberculous is quite justified, and focal and general reactions are not necessary. But it is wise to remember that in giving tuberculin therapeutically, there is a risk in using any other bacterial inoculations or milk injections at the same time as the tuberculin, on account of the allergic shock.

When tuberculin is used therapeutically, the eye should be under the constant observation of a competent ophthalmologist.

The therapeutic use of tuberculin in small increasing doses over a long period, by constantly stimulating the patient, often turns a resistant eye lesion into a yielding one; and thus

restores happiness to a hopeless patient. Unfortunately, at times, the delicate tissues of the chorioid or retina have been seriously injured before the use of tuberculin, or the tuberculous mass is too extensive to be materially helped.

In addition to the use of tuberculin, everything should be done to build up both the physical and mental health.

Encouragement is particularly important. For in tuberculous lesions of the eye, there is not the consoling feeling of hopefulness and well-being that so often accompany lesions of the lungs.

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A PRELIMINARY REPORT OF THREE CASES OF KERATOCONUS.[1]

By Drs. ERVIN TÖRÖK and L. D. REDWAY, New York.

(With three illustrations on Text-Plate III.)

KERATOCONUS is a pathologic condition of the eye in which the central portion of the cornea, without inflammatory changes, bulges forward and becomes much thinned. Because of its obscure etiology, it has been much discussed, but our knowledge of it has increased but slightly in recent years. A recent and important observation concerning it is the discovery by Fleischer of a hemosiderin ring. In 1913, Fleischer (1) described a brownish ring about one millimeter in breadth, between the periphery and center of the cornea. Histologic examinations by Fleischer and Uhthoff of microscopic specimens have revealed by the iron reactions that this ring is composed of hemosiderin which is diffused through the epithelium of the cornea. Kubik (2) by microspectroscopic examinations has confirmed this finding. But the origin of this brownish ring and of the pigment which produces it, is not as yet clear, and little may be said presently as to its frequency and significance.

Fleischer (3) originally expressed the idea that the brownish color of the ring might be derived from very fine, newly formed bloodvessels, present as secondary changes to the conus itself. But Stähli (4) opposed to this theory another: namely, that the discoloration might be derived from alkali-hematin produced by the conjunctival fluids which under certain circumstances as found in keratoconus, penetrated into the corneal epithelium. At a later time, Fleischer accepted

[1] Read before the Amer. Ophth. Soc. at Quebec, June, 1927.

Stähli's theory as the more plausible. But Koeppe (5a) basing his opinion on the fact that he has never been able to find remnants of bloodvessels in the cornea, rejects Fleischer's theory and Stähli's as well.

With the slit lamp, Meesmann (6) found in one case, concentric ruptures in Bowman's membrane at the base of the cone, and believes that the hemosiderin, or the red blood cells themselves invade the cornea from the limbus through the lymph vessels, and are deposited in the ruptures and also in the overlying epithelium.

Relative to the frequency of its occurrence, Fleischer believed it to be present in the majority of all cases, its intensity depending upon the stage of advancement as well as upon the gravity of the case. This belief has not been confirmed, however, by further observations, as, in nine cases Clausen (7) did not find it at all, and Stähli (8) in but five out of twenty-four, while Koeppe (9) found it in three out of seven cases only. In a series of six cases, three published herewith, and three others not reported, the authors did not find it.

As to the etiology of keratoconus, the newer theories may grossly be divided into two groups. The first seeks to explain it as a congenital disturbance in the development of the cornea; the second to account for it as an acquired decreased resistance of the cornea arising as a consequence of diverse affections.

Pagenstecher (10) found congenital disturbances in eleven cases. Nine showed lenticular opacities and four persistent pupillary membrane. He thinks keratoconus is due to a congenital hypoplasia of the central portion of the cornea.

Ponsy Marques (11) observed three sisters blind since birth from optic atrophy and retinitis pigmentosa, while Behr (12) describes a case with spontaneous dislocation in various joints and Shoemaker (13) one with ectopia lentis.

Several cases have been reported showing that keratoconus at times developes as a family disease and can be inherited. Stähli (14) found it in three generations. Van der Hoeve (15) describes a family of which the father had conical cornea and the mother very high astigmatism. They had six children, three of which had keratoconus and two very high astigmatism. Similar cases were cited by Wolz (16) and Terson (17),

ILLUSTRATING ARTICLE OF DRS. ERVIN TÖRÖK AND L. D. REDWAY'S, "A PRELIMINARY REPORT OF THREE CASES OF KERATOCONUS."

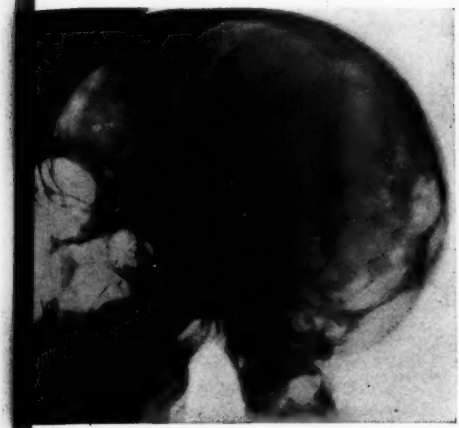

FIG. 1.

ase 1. Showing areas of rarefaction in the bones f the skull. Most marked in the parietal region.

FIG. 2.

Case 2. Shows less marked absorption.

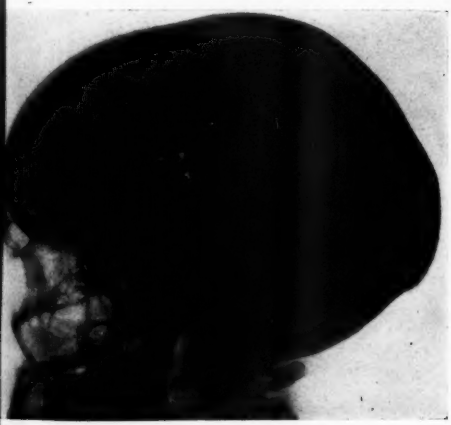

FIG. 3.

Case 2. Shows least bony absorption.

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the latter stating that in his opinion the disease is due to a predisposition often present in familial form, together with reduced resisting power and softening of the cornea perhaps on a trophoneurotic basis. Uhthoff (18) believes in a pathological disposition of the central portion of the cornea with decreased resisting power, while Erdman (19) considers it to be a congenital anomaly similar to hydrophthalmos. Stähli (20) believes that, since there is no increased tension in these cases but that anatomically and clinically the central portion of the cornea is found to be much thinner than normal, the cause of keratoconus is a disturbed relationship between the normal intraocular pressure and the resisting power of the corneal substance. This disturbed relationship, though congenital, need not cause the keratoconus to develop immediately after birth, but it may develop later similarly to myopia and may also be influenced by extraocular conditions.

The theory that conical cornea is due to an acquired reduced resisting power of the central portion of the cornea due to various local or general pathological conditions, has many adherents. Strebel and Steiger (21) found that in cases of conical cornea the sensibility is reduced at the apex of the cone, and consider this a sign indicating that the disease is of neurotrophic origin. Gonzales (22, 23) describes several cases of tropical spring catarrh followed by various degrees of changes in refraction and in a few cases by the development of keratoconus. He calls attention especially to the case of a child ten years old who suffered from tropical spring catarrh for many years, and in whom he observed the development of myopic astigmatism in one eye with keratoconus in the other eye within a period of eight months.

Wernicke (24) advanced the theory that keratoconus is due to a systematic disease affecting the connective tissues.

Wolfrum and Boehming (25) succeeded in producing keratoconus by incising the posterior surface of the cornea with the Graefe knife, and therefore believe that the disease is due to repeated small lesions of the posterior surface causing a slowly increasing thinning of the corneal tissue. Gulstrand (37) describes a case in which the apex of the cone showed pulsation. A similar phenomenon was previously observed by Javal, likewise Noyes. Gulstrand also believes that the

development of a conical cornea is more influenced by extra-ocular than by intraocular pressure (*i.e.* pressure of the eyelids upon the eyeball).

There are many who believe that the acquired pathological reduced resisting power of the central portion of the cornea is either directly due to or is combined with, endocrine disturbances.

H. Siegrist (26) reports nine cases in which he found hypothyroidism; the patients were delicate, nervous, pale, had dry skin, diminished perspiration, poor memory, loss of hair, lymphocytosis, the coagulation time of their blood being shortened. Augstein (27) observed a case of goiter, dry skin, paleness, distrophy of nails on fingers and toes, loss of hair, nervousness, lymphocytosis, but no change in coagulation time of the blood. After administration of thyroid tablets the goiter, the keratoconus, as well as the condition of the skin and the nails was improved.

Von Hippel (28) examined several cases by means of Abderhalden's dialysis method, finding disorders of various glands, such as the thymus, adrenal glands, thyroid, etc. He also found that usually several glands are affected at the same time. Also Imre (29) describes two cases showing ovarial dysfunction. Ovarian extract internally improved both cases. Their keratoconus changed into regular astigmatism.

Hack (30, 31) describes several cases showing disorders of the thyroid, while Tamascheff (32) found in two cases considerable improvement with thyroid tablets internally, and subcutaneously arsenic injections. Schnaudigel (33) observed nine cases with disturbance in the function of the thymus gland; no improvement could be obtained by administration of thymus opton.

Alajmo (34, 35) by observing the oculo-cardiac reflex, comes to the conclusion that there is a connection between keratoconus and the sympathetic nervous system, which would be in favor of the theory that the underlying cause is disturbance of internal secretion. Kraupa (36) also found that many keratoconus patients give a history of luetic infection previous to the keratoconus, and many actually show on examination tabo-paralytic symptoms, and chorio-retinitic changes. He considers keratoconus patients as degenerates, with the symptoms of Fournier's parasyphilis.

Slit lamp examination of the keratoconus shows characteristic pictures as described by Vogt, Koeppe (5a), Koby (37a), Kraupa, Augstein, and others. The most prominent symptoms are the striæ of keratoconus, and the irregular opacities of the cornea, both located at the apex. The striæ run in a radial direction, are either vertical or slightly oblique, and sometimes communicate with each other by side branches. They usually are less marked at the base of the cone than the apex. Several systems of these lines are sometimes observed crossing each other thereby forming a lattice. These striæ represent, according to Koeppe (5a) in most cases folds on the posterior surface of the cornea; those however which seem to be located in various layers of the parenchyma of the cornea, are considered by Vogt to be clefts in the corneal substance. The opacities of the cornea are irregular in shape, whiter in color and seem to be situated more superficially than the striæ. They greatly resemble an irregular macula of the cornea, which however, under the slit lamp, seems to be composed partly of lines (radial, lattice-like or concentric) and partly of actual irregular scar tissue.

Koeppe believes that as far as these opacities are concerned, we may more or less differentiate between a progressive and a stationary keratoconus, the radial, concentric or lattice-like lines representing progression, while the irregular scar tissue formation represents a stationary stage. We occasionally see ruptures of Descemet's membrane, which appear as bright lines in the zone of reflection, and as dark lines in transillumination. The corneal parenchyma appears grayish and diffusely opaque but never shows any symptoms of past or present inflammation. The endothelium looks shagreened and sometimes reddish in color; if Descemet's membrane is ruptured the endothelial cells are absent in the region of the rupture, but in the vicinity of the rupture the endothelium shows bedewing.

The thinning of the cornea is plainly visible with the slit lamp. The corneal nerves are also visible. They appear as opaque lines and seem to have a transparent glass-like sheath; both the nerves themselves and these sheaths are thickened in places, especially where they branch off. Fleischer's ring, if present, appears as a brown or brownish-green zone; it

does not show any special structure, and seems to be located in the epithelium above Bowman's membrane.

The methods of treatment may be divided into three groups:

1. Internal medication,
2. Operative interference,
3. Optical aid.

The value of internal medication is still quite uncertain, although Augstein and Tamascheff report good results from thyroid tablets, Imre from ovarian extract, and Schnaudigel that he succeeded in stopping the advance of the disease by administering thymus opton.

The operative interferences are manifold. The results, however, as to ultimate vision are not very satisfactory. So that most ophthalmologists resort to these only in the most pronounced cases. It appears that among all the operations, those are most favored which strive to produce a strong and resisting scar at the apex. This seems to be because anatomical examinations, as well as clinical observations, have conclusively proven that the thinning of the corneal tissue at the apex is a constant and very important symptom. The most frequent operation is the cauterization of the apex, with perforation, followed by iridectomy and often tattooing. Various modifications of this procedure have been advocated in recent years by Stoewer (38), Golowin (39), Golovine (40), Grunert (41) and others.

There are also several new procedures described which I may mention briefly. Lagrange (42) advises sclerecto-iridectomy, Jean (43) trephining of the apex; and covering the hole with a conjunctival flap; while Adams (44) cauterizes the apex and later makes a trephine with a small iridectomy. Wiener (45) excises an elliptical portion at the apex, suturing the wound afterwards. Mendoza (46, 47, 48) believes keratoconus is due to a disturbance in development whereby the cornea lacks resistance and the whole eyeball changes its shape and form. He tries to effect a cure by a plaster of Paris mould which is fastened upon the eyes in order to exert pressure upon them. Phosphates are given internally and the mould is worn constantly for two or three months.

To improve the sight of keratoconus patients by optical means has been tried for many years. In some cases, fairly satisfactory improvement of sight may be obtained with variously combined plus or minus spherical and cylindrical glasses. This of course can be accomplished only in mild cases, the combination of glasses to be used varying a great deal in each individual case. Hyperbolic glasses often give good results improving the sight to a great extent, but their use has been abandoned. In recent years Kramer (49, 50) has strongly advised their revival. Very good optical results can be obtained with Lohnstein's hydrodiascope, especially with the Siegrist modification, but its use is very limited because it is very disfiguring.

Pick and Salzer have tried to correct the anomalous corneal curvature by glass cups placed upon the eyeball. From this idea, the present contact glasses have been developed by Müller and Zeiss. The former are blown while the latter are ground and are therefore more accurate. These contact glasses not only improve the sight, but according to Clausen (51) also have some therapeutic properties as by supporting the apex of the cornea they prevent further ectasia. The trouble, however, is that many patients are unable to wear them on account of irritation and injury to the cornea, although cases have been published in which they were tolerated and worn without discomfort for many months, even years. Clausen (51), Dohme (52), Stock (53), Scheffels (54), Bielschowsky (55), von Hippel (56), Siegrist (57), etc.

The three cases which are reported in this instance, are as follows:

CASE 1. (Lab. No. 6360).—Miss J. H., age 27, white, American, resident of New York City.

Family History.—Father died at age of 56 years, of heart trouble. Mother living, about 50 years of age, healthy; has 5 brothers and 1 sister, all living and well. Data as to grandparents not obtainable except that patient has no knowledge of any eye trouble in them.

Past History.—Patient has had measles twice, the second attack when ten years of age and of some severity; whooping cough at six years, but no other children's disease to her knowledge. Has never had any accidents or injuries or surgical operations, except as stated below. At seventeen

years of age she had some slight digestive disturbances which were never severe and were transient. Bowels regular. Some dental caries in the past.

Menstrual History.—Began menstruating at the age of 13. Flow continued for five days, and was normal in character and amount. No pain or other disturbance of function at this time.

Chief Complaint.—About 12 years ago, while in high school, began to have headaches infrequently. These became more severe, and 9 years ago, had glasses prescribed. These were changed once about 8 years ago. Recently she has noticed that while her headaches have not returned, she yet does not see so well as before. As she is a librarian, this causes her a great deal of annoyance. But she does not have any pain or discomfort in using her eyes.

On April 21, 1926, a small fragment of glass flew into her right eye. It was removed at the Herman Knapp Memorial Hospital, where and at which time the following note was made:

Vision with present correction: R. Eye = $\frac{20}{200}$. L. E. $\frac{4}{200}$. Her refraction of that date under mydriasis was found to be:

R. −2.00 D. sph. −1.50 D. cyl. ax. 60°
L. −9.00 D. sph.

Diagnosis.—Keratoconus R. and L. eye.

Physical Examination.—On November 10, 1926, a complete physical examination was made, with laboratory studies. A moderately well-developed and nourished female. Height 67 ins., weight 128 lbs.; temp. 98.

Skin.—Moist and clear.

Tonsils.—Moderate in size, pillars very slightly reddened.

Teeth.—Fixed bridge on first and second right upper bicuspids. First left lower molar has porcelain cap.

Arch.—Has thickening in median line, mucous membrane has a slightly yellowish tint.

Tongue.—Slightly tremulous.

Neck.—Not abnormal. No adenitis.

Glands.—Cervical, axillary, epitrochlears, not enlarged.

Heart.—Normal, pulse 80, regular, good quality.

Blood-pressure.—$\frac{120}{80}$.

Abdomen.—Normal.

Reflexes.—Normal.

Joints.—Normal.

Lungs.—Normal. Respirations 13.

(Dr. Geo. Reese Satterlee).

Eyes.—Right: There is a keratoconus present, and with the slit-lamp the corneal nerves are plainly visible. At the apex of the cone there are numerous opacities, round and irregular in shape and varying in size, the smaller ones are nearer the surface, the larger ones more deeply situated. The vertical lines of the opacities appear to run through the entire stroma, and to become more and more numerous nearer the posterior surface. Fleischer's ring is not observed, but the sensation of the cornea is reduced at the apex of the cone. The horizontal lines, somewhat grey in appearance, and near the posterior surface, do not at all places appear perfectly horizontal, but are sometimes oblique, at which times they are brighter in appearance. Left: No opacities in the cornea observed, but the nerves are clearly visible, as are also the deeper striæ which in this eye are almost all oblique. No changes of pathologic significance are noted in the fundus. In both eyes with slit-lamp the cornea at the apex of the cone is found to be thinned.

Blood.—Red corpuscles, 3,720,000; white corpuscles, 5,600; polymorphonuclears, 67%; large lymphocytes, 13%; small lymphocytes, 18%; mononuclears, 0%; eosinophiles, 1%; poikilocytosis, observed; staining, normal quality; morphology, anisocytosis marked; Wassermann, negative, two antigens; Kahn, negative; hemogoblin, 60%; blood chemistry, normal limits, except blood calcium, which was not determined; blood type, type IV. (Andrew Todd McClintock Memorial Laboratory.)

Metabolism.—In order to determine as accurately as possible, this very important finding, three separate determinations were done at intervals of a few weeks apart. The average of these was taken as representing the normal, and was found to be −8.7%.

Urine.—Apparently normal. A slight trace of indican present.

X-Ray.—No evidence of infection or other abnormality in the accessory sinuses. A striking finding in the examination of the skull in general is the apparent decalcification of almost all of the cranial bones with the exception of the frontal. This decalcification is seen best in the lateral projections of the skull, and is shown as large mottled areas of decreased density, many of which have coalesced until the whole side of the skull appears to be decalcified. The sella turcica is of normal size or perhaps a little large. There is no evidence of calcification in the body of the gland.

There is much pathology of the teeth. The second upper right bicuspid is devitalized. Both apices infected. The upper left first bicuspid is devitalized; canals well filled,

with fragments of filling in bone. Granuloma. The lower left first molar is devitalized; mesial root not completely filled; apical periodontitis. There is no evidence of dental or alveolar decalcification. (Dr. R. K. Johnson.)

Treatment.—On January 14, 1927, treatment with thyroid extract, grs. ¼ twice daily was started. (Dr. L. D. Redway.)

February 21, 1927, her visual status was as follows:

Right, with old correction, $\frac{20}{100}$
Left, with old correction, $\frac{8}{100}$

R. −3.00 D. cyl. ax. 60° = $\frac{20}{100}$
L. −4.50 D. cyl. ax. 180° = $\frac{8}{100}$

Fundi normal. (Dr. Ervin Török.)

March 25, 1927, her visual status had changed to:

Right, with old correction, $\frac{20}{100}$
Left, with old correction, $\frac{10}{100}$

R. −2.50 D. sph. −3.50 D. cyl. ax. 75° = $\frac{15}{15}$
L. −6.00 D. sph. −3.50 D. cyl. ax. 105° = $\frac{20}{100}$

April 15, 1927, she was working steadily, had added the teaching of 8 classes a week to her regular librarian's work and had had no feeling of increased nervousness. She adds that her eyes do not feel fatigued under this load, nor does she feel that the increased work is beyond her normal physical capacity. Notices that she can now read "Movie" titles from the rear of the theatre where before she had to sit in the second or third row front to do this. Blood pressure today $\frac{120}{80}$. Pulse 76, regular, good quality. Has gained three pounds, in weight, present weight being 131. No menstrual disturbance in function. Blaud's pills prescribed, one pill daily. (Dr. L. D. Redway.)

Case 2. (Lab. No. 6445).—Miss M. A. H., æt. 38, white, American, resident of San Francisco.

Family History.—Father and mother always healthy. No history of eye trouble of any kind in either paternal or maternal grandparents. One sister alive and well, but with no history of eye trouble of any sort.

Past History.—Several very slight attacks of appendicitis when young. Appendix removed in San Francisco by Dr. Coffey in 1921. Improvement in general health followed. In 1924, several attacks of tonsillitis, following which tonsils were removed by Dr. Bricker in San Francisco.

Measles, pertussis, chickenpox in childhood. Has never at any time had "rheumatism."

In 1921 consulted Dr. M. Mentzer of San Francisco for

general fatigue and exhaustion, following appendectomy. Physical findings at that time were: Focal infections of teeth; tonsils (removed 1924): 3 + Wassermann, secondary anæmia with possible hyperthyroidism. (No basal metabolism done then.)

Chest.—Left cervical muscles tense, restriction of motion, left side, resonance diminished, fremitus increased over left apex, broncho-vesicular breathing over second rib anteriorly and from apex to hilus posteriorly. No râles.

Since September, 1923, blood Wassermann consistently negative, following treatment. In August, 1925, acute respiratory infection. September 26, 1925, began to complain of continuous orbital and occipital headaches. Referred to Dr. Hans Barkan.

Dr. Barkan's records as follows: Past six months pain in orbits and occipital headaches on near work. Past two weeks, severe pain and headaches. Glasses prescribed.

R. −0.37 D. sph. −1.00 D. cyl. ax. 170° = $\frac{8}{10}$.
L. +0.50 D. sph. +1.00 D. cyl. ax. 100° = $\frac{8}{10}$.

R. = J. III. at 25 c.m. p.p.
L. = J. I. at 21 c.m. p.p.

Binocular and stereoscopic vision, normal. Keratoconus. Retinoscopy = target shadow with reversed movements. In November, 1925:

R. −0.50 D. sph. + 1.50 D. cyl. ax. 160° = $\frac{8}{10}$
L. −0.75 D. sph. + 1.00 D. cyl. ax. 100° = $\frac{8}{10}$

With this correction headaches cleared up and was able to read for much longer periods. (Dr. Hans Barkan.)

March, 1926, she complains again of fever, cough, occasional expectoration, ache under the *right* scapule, with return of fatigue. Physical examination showed: weight 135 lbs.; temp. 98.4; P. 108; R. 24; blood pressure, $\frac{114}{80}$; chest, symmetrical, movements equal, bronchial breathing on *right* normal; broncho-vesicular breathing over *left* apex; coarse, inspiratory râles, both apices, both anteriorly and posteriorly. Fine, dry crepitations around the angle of the scapule may be pleural. (Dr. M. Mentzer.)

Chief Complaint.—Defective vision.

Physical Examination.—Well developed and nourished female, height 69½ ins., weight 135 lbs., temp. 98. Thyroid slightly enlarged; palpable axillary glands; maxillary and cervical glands not palpable.

Skin.—Dry; hair and fingernails brittle.

Tonsils.—Absent.

Teeth.—No pivot teeth, but fixed bridge. One or two dead teeth.

Chest.—Subcostal upper and lower dullness, diminished breathing.

Heart.—Normal rate 84.

Blood Pressure.—$\frac{100}{70}$.

Abdomen.—Narrow subcostal angle. Old right rectus scar. Faint crepitation over ceco-colon. Abdomen perfectly soft and apparently normal. No adenitis. Tissue shows some wasting.

Reflexes.—Patellar ++, both sides.

Feet.—Normal.

G.—U.—Slightly tender cervix, no discharge.

Eyes.—Right: Beginning keratoconus. V. = $\frac{10}{200}$. With correction (+1.00 D. sph. −2.00 D. cyl. ax. 90°) $\frac{20}{100}$. Fundus normal. No corneal opacity. Fleischer's ring not present. A few scattered pigment deposits are observed on the posterior surface of the cornea. Corneal nerves are plainly seen with slit lamp. Left: Beginning keratoconus. V. = $\frac{10}{200}$; with correction (−1.00 D. sph. −1.00 D. cyl. ax. 90°) V. $\frac{20}{50}$. No opacity visible at apex or elsewhere, but the corneal nerves are plainly seen with slit lamp. Slit lamp shows thinning of the cornea at the apex of the cone in both eyes. Sensitiveness of cornea reduced at apex in both eyes. (Dr. Ervin Török.)

Blood.—Red corpuscles, 3,410,000; white corpuscles, 6,500; polymorphonuclears, 64%; large lymphocytes, 4%; small lymphocytes, 31%; mononuclears, 0%; eosinophiles, 1%; poikilocytosis, absent; staining, normal; morphology, normal; blood chemistry, normal limits, except blood calcium, which was not determined; Wassermann, negative, two antigens, Kahn, negative, 70% (Newcomer); blood type, IV. (Andrew Todd McClintock Memorial Laboratory.)

Metabolism, average of three determinations, − 18%; urine, normal.

X-Ray.—Little evidence of bony decalcification in the skull. Marked area of rarefaction in the occipital region, but this is frequently seen in a normal skull. The sella turcica is very small and the clinoid processes are very heavy and almost touching each other. Moderate lordosis of upper spine (thoracic).

Shadows at hilum are normally dense and evenly distributed, both sides. Lung fields are clear except for a small spot at each apex, posteriorly, the one at the left apex being the larger and more definitely calcified. There is also an area behind the right second interspace which suggests a localized peribronchial infiltration, possibly of tuberculous

origin. There is also a small spot behind the sternal extremity of the first rib. The findings are suggestive of early and moderate tuberculosis. (Dr. R. K. Johnson.)

Treatment.—On January 26, 1927, treatment with thyroid extract grs. $\frac{1}{10}$ b. i. d. was begun. (Dr. L. D. Redway.)

Same date, the vision, with correction, was R = $\frac{20}{100}$; L. = $\frac{20}{40}$.

During the period December 27, 1926, to February 15, 1927, this patient was doing very arduous post-graduate work at Columbia University and using her eyes from 9 A.M. to 12 P.M. daily. In addition, she had the nervous strain and worry incidental to mid-year examinations. She reports some fatigue, but no headache. On this date her temperature was 97.1 in the A.M., and she complained of several nose-bleeds. No cough. Some hypertrophy of middle turbinates. (Dr. Irving Voorhees.)

Weight 131½ lbs. No menstrual disturbance.

On Feb. 12, 1927, her vision was:

R. = $\frac{20}{100}$; with +1.50 D. sph. −2.00 D. cyl. ax. 45° V. = $\frac{20}{20}$
L. = $\frac{20}{70}$; with +2.50 D. sph. −3.00 D. cyl. ax. 115° V. = $\frac{20}{20}$
(Dr. Ervin Török.)

Feels a distinct improvement in general health. Has more energy, and does not fatigue so rapidly. Has a little difficulty in sleeping. No palpitation. Blood pressure $\frac{105}{70}$. Does not notice much improvement in vision, but less fatigue on application to near work.

On March 26, 1927, reports that last menstrual period was slightly painful and lasted longer than usual. But to her usual university work she has added since February 15, two night classes. Occasional headache, controlled by aspirin. Vision: R. = $\frac{20}{40}$ minus; L. = $\frac{20}{30}$ minus, with correction. (Dr. L. D. Redway.)

CASE 3. (Lab. No. 6438).—Miss M. D., æt. 23, white, Canadian, resident of Nova Scotia.

Family History.—Father dead, mother living and well. One sister. No history of eye trouble in either paternal or maternal grandparents.

Past History.—Diphtheria and scarlet fever when 7 or 8 years of age. Otherwise, health in early life good. Menstruation commenced at 13, and has been regular and painless. Influenza in 1925, with following pneumonia. Bronchitis last 5 years both spring and fall. Began to notice some difficulty in reading 4 or 5 years ago. Five years ago had adenoids removed because of difficult breathing. Subsequently had some bone removed from nose as

relief from removal of adenoids was not complete. Bowels always sluggish.

Chief Complaint.—Difficult vision.

Dec. 11, 1924, V. without glass, R. $\frac{1}{10}$, L. $\frac{6}{10}$; with glass, R. −1.00 D. sph. −1.50 D. cyl. ax. 55° = $\frac{8}{10}$; L. +.25 D. sph. −1.00 D. cyl. ax. 107° = $\frac{6}{10}$.

Dec. 9, 1925, V. without glass, R. $\frac{1}{10}$, L. $\frac{6}{10}$; with glass, R. −.75 D. sph. −1.50 D. cyl. ax. 45° = $\frac{8}{10}$; L. +1.00 D. cyl. ax. 170° = $\frac{6}{10}$.

June 17, 1926, without glass, R. $\frac{1}{10}$, L. $\frac{6}{10}$; with glass, R. −.50 D. sph. −1.00 D. cyl. ax. 45° = $\frac{1}{10}$; L. −1.00 D. cyl. ax. 175° = $\frac{6}{6}$. (Dr. C. B. Trites.)

Physical Examination.—November 16, 1926. Tall, poorly developed female. Height 68½ ins. Weight 124 lbs. Temp. 98.5.

Skin.—Muddy, with general acne, and greasy.

Tonsils.—Fossæ clean.

Tongue.—Little, flabby, and tremulous.

Glands.—Thyroid not enlarged; no cervical or maxillary adenitis.

Heart.—No murmurs or enlargement. Rate 80.

Blood Pressure.—$\frac{110}{70}$.

Lungs.—Deficient inspirations, no râles.

Abdomen.—Hyposthenic type, narrow subcostal angle, male pubes, no inguinal adenitis.

Reflexes.—Patellar, normal.

Chest.—Examination by fluoroscope of chest and esophagus, negative.

G. I.—Stomach, regular outlines, fishhook in shape, tone good. No filling defects. Motility satisfactory. Serial examination essentially negative; no evidence of gastrointestinal abnormality, either congenital or acquired.

Skull and Sinuses.—Left antrum mottled in appearance. The density of the cranial vault, particularly of the parietal bones, is in places diminished, suggesting deficient calcification.

Teeth.—Small root fragment of the upper left first molar. Large subgingival stump of the second left upper molar. Area around this suggests early cystic development. No evidence of decalcification of teeth. (Dr. R. K. Johnson.)

Eyes.—Right: There is a keratoconus present, greater in the right than in the left. Opacities are seen under the epithelium, and rupture of Descemet's membrane noted. Horizontal lines are seen at the apex of the cone formed by these opacities, with side branches. Left: The apex of the cone exhibits horizontal lines and a large horizontal tear in Descemet's membrane. The endothelium is folded vertically into very fine folds. Nerves are plainly visible.

Fleischer's ring is not visible in either eye.
Sensation is diminished at both apices.
Tension cannot be taken in either eye.
Vision, Right = $\frac{6}{100}$; left = $\frac{10}{40}$, uncorrected.

Blood.—Red corpuscles, 3,790,000; white corpuscles, 5,850; polymorphonuclears, 50%; large lymphocytes, 26%; small lymphocytes, 21%; mononuclears, 2%; eosinophiles, 1%; poikilocytosis, marked; staining, normal; morphology, normal; Wassermann, negative; hemoglobin, 71% (Newcomer); blood chemistry, normal limits; blood type, IV. (Andrew Todd McClintock Memorial Laboratory.)

Metabolism, average of three determinations, −5%; urine, normal.

On January 3, 1927, she was placed on diet for intestinal toxemia.

On January 19, 1927, right upper wisdom tooth removed. Less constipation.

Thyroid extract grs. $\frac{1}{10}$ b. i. d. commenced.

March 3, 1927. V. R. = $\frac{6}{100}$
V. L. = $\frac{10}{40}$
R. Homatropine. Not possible to shadow. Pinhole does not improve. Shadow hyperopic
L. +1.25 D. sph. +0.75 D. cyl. ax. 180° = $\frac{10}{40}$ (Dr. Ervin Török)

March 10, 1927. V. R. = $\frac{6}{100}$; no improvement with glasses.
V. L. = $\frac{10}{40}$; +0.50 D. sph. +1.00 D. cyl. ax. 180° = $\frac{10}{10}$.

On April 16, 1927, reports she is employed as a mailing clerk and switchboard operator (2 hrs. daily). Feels that her "pep" is increased. Says that her eyes do not tire at all. V. R. = $\frac{20}{100}$; V. L. = $\frac{10}{10}$ with a little effort; corrected. Says that her last period was very scant, and that the one due last week has not appeared. Pulse 80. But she can put in a full day without fatigue.

The points of interest in these studies are, it seems, these: The low basal metabolic rates. While these rates are not excessively low, yet they do point definitely and persistently to hypofunction in the thyroid and possibly in other glands of internal secretion, thus confirming the findings of Von Hippel (38) and others.

The areas of rarefaction found in the cranial bones. When

these were discovered, X-rays were subsequently made of all the bones, and these carefully studied in order to ascertain whether this rarefaction was present elsewhere. This was found not to be the case, the bones of the skull alone being involved. It would have been of great interest, had time permitted, to have studied the calcium metabolism in these patients, and it is proposed to do this subsequently, but in addition to the time necessary, the technique is quite difficult if reliable results are to be obtained. It is possible that the chalky teeth of Case No. 1 may be related to this calcium change. In degree of severity, No. 1 showed the most profound changes in the skull bones, No. 3 the next most, and No. 2 the least. This is interesting, as the severity of the keratoconus follows the same order, but there is no ground on which to base the assumption that this is more than mere circumstance. It does, however, offer an interesting opening for further study of the calcium metabolism and its possible relation both to the pathology of the skull bones and to the keratoconus, if such exist.

The blood: It will be noted that in all cases there is a markedly low hemoglobin percentage, together with a diminished red cell count. This, in our experience, is not inconsistent with a low metabolism rate, and should be associated with a leucopenia, which is found. There is not only a relatively low hemoglobin percentage, but also an actual lowering of the hemoglobin. Such findings are usual in long standing cases of chronic infection, and are probably inter-related. For this reason it becomes difficult to say whether the low metabolic rate is due to glandular disfunction, or is present as a result of the low values of red cells and hemoglobin.

The significance of the type four classification of all three bloods is not understood, but is thought to be coincidence. The fact that the blood chemistry in all three cases was within normal limits (except calcium which was not determined) is fortunate, in that it permits to be discarded one factor in a series of variables. But it would seem highly important that the calcium metabolism be studied in some detail in view of the findings in the skull bones.

X-ray findings: The rarefaction of the bones of the skull, and in especial of the parietal bones, is very marked in one

case and less so in the other two. It may be merely coincidence again, that the degree of rarefaction varies as the severity of the conus in these three cases, but whether this rarefaction has any relation to the calcium metabolism, and whether both of these are related in some manner to the production of the conus, or whether all three conditions are the result of some other yet undetermined factor, it is impossible to say.

The metabolism rate: In all cases, this was slightly subnormal. In two cases, Nos. 3 and 2, it will be noted that there is a history of antecedent infection, with present evidence of a good deal of focal infection. In case 1, however, this is minimal in amount. Thus in considering the metabolism rate, it is wise to discount the effect upon this of the chronic infection with the consequent low hemoglobin percentage and reduction in number of the red cells per c.mm. It is possible that we have here cause and effect directly, that the depressed metabolism rate is due to the relatively increased katabolism, with its destructive influence on the blood cells, and not directly to hypofunction on the part of the glands of internal secretion. But there is too much evidence to disregard the factor of hypofunction of the glands of internal secretion. Yet we find if the basal metabolism rate is in any way an accurate measure of this function, that in these relatively severe cases this is not lowered to any great degree. And this in spite of the coexistence in two of these cases of relatively severe focal infections.

It is therefore not improbable that other factors still must be considered. Certainly keratoconus is comparatively rare, and hypofunction of the glands of internal secretion relatively frequent. Yet although a great many cases of keratoconus have been observed to present also a thyroid disfunction, very few cases of thyroid disfunction present also a keratoconus. And in view of the other findings, it may not be impossible that hypofunction of the internal secretory glands *together with* an altered calcium metabolism may play an etiologic part in the production of the conus.

Treatment.—While it is true that visual improvement has resulted from the administration of thyroid extract in these cases, no changes in the characteristics of the conus have as

yet been observed, and it is therefore not improbable that the thyroid substance may have accomplished this improvement, by producing an alteration in the retinal circulation, or by stimulation of the central nervous system. Much further study is needed to clarify these points, and it is hoped that these cases may be continuously studied over a period of years in order that further data may be obtained.

The authors are indebted to Drs. George Reese Satterlee, Redford K. Johnson, Mary Mentzer, Hans Barkan, C. B. Trites and Irving Voorhees for their histories and kindly professional coöperation, as well as to the Andrew Todd McClintock Memorial Research Laboratory for the very careful and elaborate studies in metabolism and clinical pathology by Mr. Michael Turpak which have made this report possible.

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LENTICONUS POSTERIOR.[1]

With a Report of a Case Studied with the Slit Lamp with two Drawings.

By Dr. HENRY H. TYSON, New York.

(With two illustrations on Text-Plate IV.)

A CAREFUL review of the literature reveals the fact that cases of true lenticonus posterior are very rare, numbering about six altogether; as many of those previously reported as true cases could not withstand the "acid test" of confirmation by an examination with the slit lamp, and must therefor be relegated to the division designated by Von Szily as "double focus lens" or as called by Riedl "central lens myopia." The diagnostic signs of the "oil drop appearance" surrounded by a variable shadow, with a great increase in the refraction, usually high myopia, as measured through the center of the conus, when compared with that of adjacent or surrounding lens area, are the ones which first attract the attention when the eye is being examined with the ophthalmoscope or retinoscope. In addition to the aid in diagnosis rendered by a general study of the posterior surface of the lens with the slit lamp, Gullstrand in studying the movement of the Purkinje images of the posterior surface of the lens, demonstrated another valuable sign in noting the movement of the reflection on the posterior surface, thereby determining the form and changes in the curvature of the surface. This sign is of value in the differential diagnosis between true and pseudo-lenticonus posterior cases.

The history of the case is that:

J. W. T., aged 25 years, male, chauffeur, applied at the Knapp Clinic for glasses to relieve the poor vision in his

[1] Case presented before the Section on Ophthalmology of the New York Academy of Medicine, October 16, 1927.

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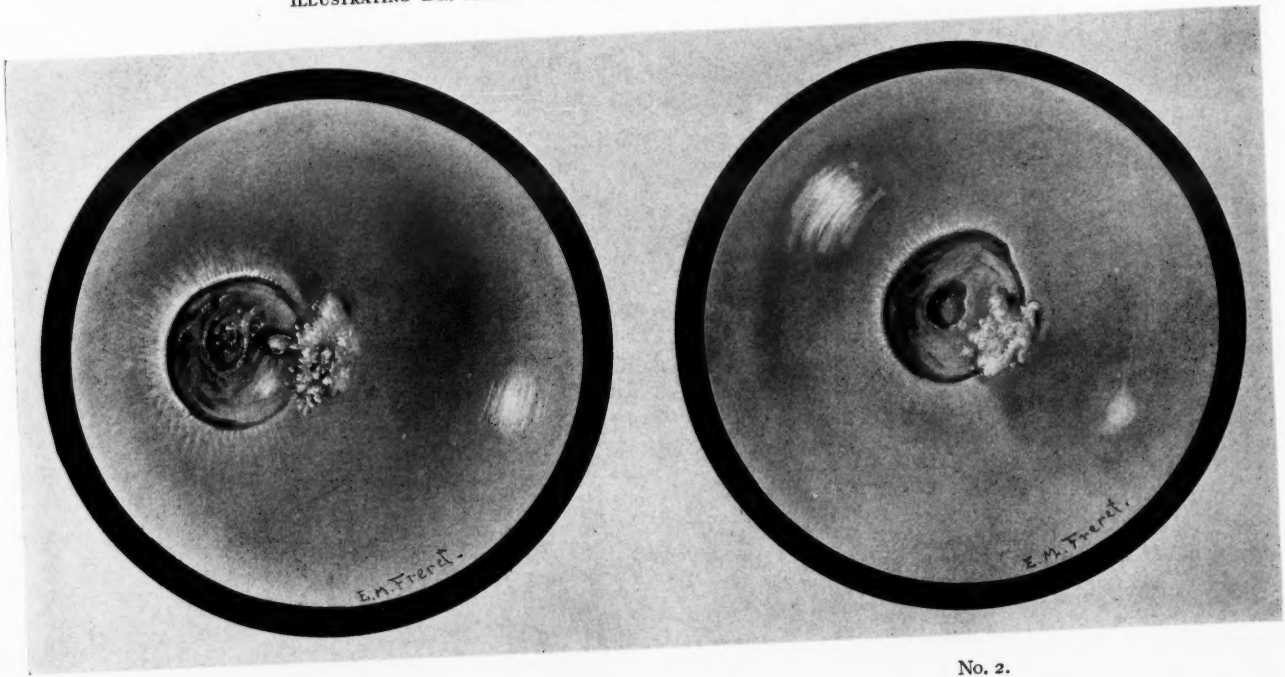
ILLUSTRATING DR. HENRY H. TYSON'S ARTICLE, "LENTICONUS POSTERIOR."



No. 1.
Angular view.

No. 2.
Antero-posterior view.

UNIV. OF MICH.

left eye, which had existed all his life. Vision R. $\frac{10}{20}$, L. $\frac{10}{100}$, w. $-2.75 = \frac{10}{10}$. Vision not improved with stenopaic or pin hole disk; but was better without them. No history of trauma. In examining his eye with the ophthalmoscope the "oil drop appearance characteristic of the condition was present, associated with a small opacity in the posterior cortex of the lens running back near the posterior pole, but not reaching it, and with a great difference in the refraction existing between that of the center of the protruding conus and that of the surrounding peripheral lenticular zone, amounting to about twenty dioptrics of myopia: with a sudden distortion of the images at the margin of the base of the conus, which are signs indicative of true lenticonus posterior. The eye backgrounds including the vitreous were normal, while with the slit lamp the picture varied constantly depending upon the angle and depth of focus used. The two drawings presented give a very fair idea of the appearance, one as seen from an angle, and the other straight back. The anterior part of the lens was normal including the embryonal nucleus. The anterior "Y" was readily seen in the normal position, the striæ being rather more marked than normal. The posterior "Y" on the other hand was apparently seen in parts and with great difficulty: as it was masked by the white reflex from the opacity lying just behind it.

The posterior surface of the lens was marked by a saucer like depression projecting into the vitreous (regarded from the anterior view) approximately circular in outline, but somewhat irregular and wider below than above. It occupied about $\frac{1}{5}$ the diameter of the posterior lens surface, and its depth appeared to be about $\frac{1}{3}$ of its diameter, the edge being fairly sharp, but not knife like. The posterior lens surface immediately surrounding this depression was rather hazy in irregular patches, and within the depression itself, the surface showed several round or oval areas of opacity, and other areas of roughening which caused an irregular reflection of the light beam giving the effect of opacity, though nor really opaque. When the dot beam was used in the examination and was focused on the posterior pole of the flattened conus, the entire depression became illuminated at once, giving the effect of a dome or flattened hemisphere. The shagreen of the posterior reflecting surface was of canary yellow color due probably to the ordinary deep yellow appearance being seen through the gray cortex, the mixture giving the effect of a light yellow color. Embryonal hyaloid remains were not recognized, either because absent or obscured and confused by the opaque or hazy areas described. The ring reflex of Vogt,

though present was not marked, being at times bright and then in part gray or opalescent, and lacking the fiery brilliance described in other cases. This may be due to the relative shallowness of the conus in this case, with resultant obtuseness of the angle of demarkation. This shallowness may also account for the absence of the horizontal lightband noted in Dr. Marsh's case, when the vertical slit beam crossed the edge of the conus.

An additional feature of the case was an irregular conical opacity in the posterior part of the lens, situated axially between the embryonal nucleus and the normal position of the posterior pole. Broad and flat anteriorly it had an irregular posterior taper to an end like a trumpet mouth, at about the normal curve of the posterior surface. No connection between it and the actual surface could be seen, but possibly some fine threads may extend backward to the surface, concealed on account of the possible angle of observation. Except for its separation from the actual surface, and its irregular form, this opacity resembled one shown and described by Vogt (as figure 234 of his atlas).

In its anatomical as well as its mathematical characteristics, the conus in this case seems to occupy a position between Dr. Marsh's case and the one described by Vogt.

Of the many theories advanced as to the etiology in these cases, that of Collins and Mayou, "that it appears as the result of a developmental defect in the posterior lens capsule" seems the more tenable in this case.

As previous observers have given careful and interesting résumés of the literature with reference to the various theories as to its etiology, I will omit a repetition of the same. The additional case here reported is with the hope that in its analytical study and consideration in conjunction with those previously reported that it may be instrumental in aiding in the solution of some of the disputed or unsolved points.

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LENS PROTEIN—NEW METHODS FOR THE PREPARATION OF BETA CRYSTALLIN.

By Dr. EARL L. BURKY and Dr. ALAN C. WOODS, Baltimore, of the Wilmer Ophthalmological Institute, Johns Hopkins Hospital.

IN a previous paper (Woods and Burky) (1) the isolation of serologically pure Alpha and Beta lens crystallin was reported. The object of this paper is to report two recently developed methods for the isolation and purification of Beta crystallin. These methods appear more practical, and the substance isolated is identical with Beta crystallin prepared by the original method. For convenient reference, Table II is added to this paper, summarizing the methods for the preparation of whole lens extracts and the fractions, Alpha and Beta crystallin.

The original method of preparing Beta crystallin was long and time-consuming. The final yield was small, and in many instances after concentration by NaCl, it was found to contain traces of Alpha crystallin. For these reasons a more convenient method of purification was sought.

The first method devised was the result of observations made in the course of concentration of Beta crystallin prepared by the original method. It was found that when an impure acid (pH 5.0) Beta solution was saturated with NaCl, a precipitate occurred which contained all the Alpha crystallin and some of the Beta crystallin, but the greater portion of the Beta remained in solution. This observation suggested the following procedure.

Method I.—A filtered whole lens extract was used. The Alpha fraction was precipitated by acetic acid, and the precipitate was filtered out. The impure Beta crystallin filtrate

was dialyzed in collodion bags to pH 7.4. It was then saturated with NaCl. Portions of 20*cc* were treated with increasing amounts of N/10 acetic acid with the results shown in Table II.

TABLE I.

EFFECT OF ACID PRECIPITATION ON IMPURE BETA SOLUTIONS, SATURATED WITH NaCl.

Acetic acid N/10–cc	*Precipitation*	*State of supernatant fluid*	*Ph of supernatant*	*Reaction of Alpha serum*	*Supernatant with Beta serum*
0.2	+	sl. turbid	5.5	+	+
0.4	+	clear	5.2	+	+
0.6	+	"	4.8	+	+
0.8	+	"	4.8	−	+
0.1	+	"	4.6	−	+

From this it is evident that an Alpha impurity can be precipitated completely from a Beta solution, saturated with NaCl, by the addition of acid to pH 4.6.

The main portion of the solution was therefore treated with N/10 acetic acid in the proportion of 1 *cc* acid to 20 *cc* of solution. The resulting precipitate was filtered out. The

TABLE II.

BOVINE LENS EMULSION

EMULSIFIED LENS + N/100 NH_4OH (TRICRESOL 0.5%) IN PROPORTION OF ONE LENS TO 20*cc* SOLVENT. SHAKE IN SHAKING MACHINE OVERNIGHT; REFRIGERATE 48 HOURS; CENTRIFUGE.

Sediment (X)	*Supernatant*
Injected into rabbits, produces precipitins for Alpha and Beta Crystallins. Centrifuge and wash with distilled water until wash fluid gives negative ninhydrin test. Remaining sediment injected into rabbits produces antiserum identical with pure Alpha antiserum. Sediment X = insoluble Alpha crystallin.	Filter through Berkefeld to clarify and to sterilize. This is *Whole Lens Protein*, containing both Alpha and Beta crystallin. Solids content is 1.5%. Add N/10 acetic acid to the above solution to pH 5.2 −4.8. There occurs a precipitate (impure Alpha) and supernatant (impure Beta).

Supernatant (impure Beta)	*Precipitate (impure Alpha)*
To Purify: (original method) Dialyze under toluol to pH 7.6. Add N/10 acetic acid to maximum precipitate. Discard precipitate. Dialyze and repeat precipitation until supernatant no longer reacts with pure Alpha serums. To produce more concentrated solutions more quickly: *New Method I.*—Dialyze free of acid. Saturate with NaCl. Add 1 *cc.* N/10 acetic acid for each 20*cc* of solution. Filter out and discard precipitate. Dialyze free of chlorides. This produces an antiserum which reacts with Beta and does not react with Alpha antigens. This antigen does not react with Alpha antiserums. Antigen is *pure Beta Crystallin.*[1] *New Method II.*—Saturate whole lens protein with NaCl. Filter out and discard precipitate. To filtrate add 0.1% glacial acetic acid. Filter out precipitate and dissolve it in minimum N/10 NH_4OH. Dialyze resulting turbid fluid free of chlorides. Add N/10 acetic acid to produce maximum precipitate. Supernatant fluid is *Pure Beta Crystallin.*[1]	To Purify: Dissolve in N/10 NH_4OH and H_2O to volume equal to previous volume and pH 7.6. Dialyze in collodion bags under toluol for 24 hours. Repeat precipitation with N/10 acetic acid to pH 4.8. Centrifuge out precipitate. Discard supernatant. Redissolve in N/10 NH_4OH and water as before. Dialyze as before. Repeat precipitation, solution, and dialyzation until Alpha no longer reacts with potent Beta serums. About 15 precipitations are required. This substance injected into animals produces precipitins reacting with pure Alpha antigens, and not with Beta antigens. *Pure Alpha Crystallin.*

NaCl was removed from the filtrate by dialyzation. The final product reacted with Beta serum and did not react with Alpha serum. When injected into a rabbit, it produced an antiserum which reacted with its homologous antigen and with other Beta antigens, but did not react with Alpha antigens.

This method has the advantage of recovering both the Alpha and Beta fractions from one preparation, but if Alpha crystallin is not particularly needed, the following method is more convenient and the yield of Beta is possibly greater.

Method II.—The results obtained by the first method led us to saturate whole unfiltered lens extract with NaCl to

[1] Pure beta crystallin in sense that it is free from Alpha impurities. There is some evidence it may be a complex antigen.

determine whether the Alpha could be precipitated by one manipulation rather than two. It was found that the greater part of the Alpha was precipitated by NaCl without the addition of acid. The precipitate was filtered out and discarded.[1] To the filtrate was added 0.1% glacial acetic acid. The resulting precipitate was filtered out. The precipitate was taken up in sufficient N/10 amonium hydroxide to produce pH 6.0 in the resulting turbid solution. The NaCl present was removed by dialysis. The solution when freed of chlorides was still turbid and the filtration did not entirely clear the solution. Sufficient N/10 acetic acid to produce precipitation with a clear supernatant fluid was then added. The precipitate was removed by centrifugation and the supernatant fluid contained Beta crystallin in a concentration of approximately 1.5%. This preparation reacted with Beta serums and did not react with Alpha serums. When injected into rabbits it produced an antiserum which reacted with all Beta antigens and did not react with Alpha antigens.

This method is especially interesting in that it shows that Beta crystallin, ordinarily not precipitated by acid, is precipitated by acid in the presence of necessary electrolytes. (NaCl).

Discussion.

Beta antigens prepared by these methods, adjusted to pH 7.4 and sterilized by Berkefeld filtration have been uniformly stable preparations. In the previous paper (1) the instability of Beta preparations at pH 7.4 to pH 5.0. was noted and commented upon. Because of this discrepancy, the earlier preparations were carefully re-examined and found sometimes to contain either slight traces of Alpha or some other impurity.[2] The precipitate which occurs spontaneously,

[1] This precipitate contains Alpha and Beta crystallin. The amount of recoverable Beta is so slight that its recovery is not justified. The Alpha crystallin is so denatured by the NaCl that it is only slightly soluble in water and weak alkali and as the process of purification of the soluble part is continued this, in turn, also becomes insoluble.

[2] There is some evidence pointing to the possible existence of a third fraction in the lens substance, which may contaminate both fractions, thereby producing the confusing precipitin results encountered early in this investigation.

consists of all the impurity, together with large amounts of Beta crystallin, leaving in solution a small portion of the Beta crystallin. Attempts to separate the component parts of this precipitate have been so far unsuccessful.

The previous statement concerning the instability of Beta crystallin therefore requires some modification. Beta crystallin, in the presence of traces of some impurity, is unstable between pH 7.4 and pH 5.6.

Summary.

New methods are described for the preparation of Beta crystallin of lens substance. These methods are more rapid, the results more assured and the yield greater than in methods previously described.

REFERENCE.

1. Woods and Burky. *J. Am. Med. Assn.*, 1927.

NON-OPERATIVE TREATMENT OF CATARACT WITH REPORT ON LENS ANTIGEN TREATMENT.[1]

By Dr. ZENAS H. ELLIS, New York.

WITHIN the last few years the members of the medical profession have had many new discoveries displayed before them for their approval, a few of value, others of no worth. Perhaps the one that ophthalmologists should be especially interested in is the announcement by Dr. A. E. Davis at the International Congress of Ophthalmology in 1922 and at the American Ophthalmological Society in 1924 that he had arrived at a cataract preventative or cure without resort to surgery. In his report he announces that 72 patients with 131 cataracts had been treated. Of these cases he reported 36 cases or 27½% as being arrested cases, in 86 cases or 65% the cataract was either cured or improved, making a grand total of 93% of the cataracts which had responded favorably to his treatment. Such a "cure" if based on scientific truth is of the utmost importance, for the disease entity known as cataract is an ancient one, and has withstood the attack of ages of learned men who have sought to conquer it by every conceivable remedy other than the knife, with little or no success.

Such a revolutionary discovery as the finding of a mode of treatment which gives arrest in 85% of the cases treated and improvement in over 50% of the cases treated is worthy of further study by others of an unbiased mind. If these facts be true and we have a real definite mode of treating cataract of whatever form, it is vital that this fact should be broadcasted not only to the medical profession but to the laity generally so that all may share in the benefits to be derived, for cataract is a common medical condition and if it is possible in

[1] Read at the Annual Meeting of the Medical Society of the State of New York at Niagara Falls, N. Y., May 11, 1927.

early cases to stop the progress of cataract, the people generally should be as acquainted with the fact, as they are now with the necessity of early treatment of cancer and tuberculosis and diabetes. If in addition to being able to prevent the formation of cataract in the early cases we can promise half of our cases cures after the cataract has formed and that the opacities will clear up, we truly have a remedy of inestimable value.

The ophthalmologist asks, are these facts true? He turns to the American Medical Association and enquires of the Council on Pharmacy and Chemistry whether the lens antigen treatment of cataract has been passed upon by their board and he finds that while this preparation has been presented to them they have not passed upon it for the ophthalmologists consulted all agree that the evidence of its usefulness was not acceptable. They await more evidence. It should be for ophthalmologists themselves to inform the council as to its efficacy and advocate its approval or disapproval by that impartial board.

At Bellevue Hospital and in connection with the Eye Department of New York University and Bellevue Medical School there has been going on for several years a study of this most timely subject, the medical treatment of cataract. It was considered momentous to first of all look about and see whether any of the remedies that so far had been advanced offered a real cure and if not, to dismiss them from discussion. Not an easy task but an essential one.

As in the case of many other diseases, the treatment of which is poorly understood, the treatment, of cataract has embraced nearly every conceivable remedy. Generally speaking, all have yielded most unsatisfactory results with the exception of the brilliant results in a very high percentage of cases following the various surgical procedures of extraction of the crystalline lens. The very fact that so many various modes of treatment have been advanced for the relief of this condition predisposes to the view that no worth while results were obtained with any. The treatment of incipient cataract then has resolved itself into the use of various medications in the conjunctival sac or injections beneath the conjunctiva in connection with internal medication which might aid in the process of staying the opacification or possibly actually aiding in its absorption. As

many cataracts seem to be self limiting and never go on to maturity and as some even seem to disappear automatically (although these cases are rare and their certainty is doubted by many authorities) the actual results obtained by the medication given is at best uncertain.

It is with this fact in mind that we approached the problem of arriving if possible at some definite treatment for the cure of cataract without resorting to surgery, or if this were impossible, frankly to admit that the condition was surgical and relegate drug therapy to its rightful position.

In studying the literature of what had previously been accomplished in this field of research we were struck by the account of the results found by Guyer and Smith. They began their work on the action of cytolysins and it was really only by chance that their work has had such bearing on the study of cataract. A brief outline of the work of these two men and their findings directly bearing on the work at hand might not be amiss. They found that lens tissue of rabbits and mice when injected into fowls excites the production of anti-bodies. The serum of the fowl when reinjected into rabbits and mice may attack in utero the lenses of the young of the species used as antigen. The reaction is not invariable; a majority or even all of the litter may not be acted upon, or a given individual may be affected only in one eye. The reason may be that the placenta is impervious to such antibodies except when there is an occasional rupture of a placenta blood vessel which might permit of direct mingling of fetal and maternal blood.

Various defects were noted among the offspring of animals injected with the serum. The liquefactions would indicate a true cytolytic effect; of the several lens proteins the fibrous one is the one upon which the sensitized serum seems to have operated. Whether the other ingredients were also affected was not determined.

The clouding which occurred in other lenses might either be the result of a cytolysin or precipitin. The important point is that opacities which may be permanent can be produced by specific sera. In the most striking case the affected lens was so diminished in size that the whole eye was microphthalmic.

It will be noted that Guyer and Smith found that the anti-bodies injected into animals had no effect on the lens or any

other of the orbital contents of the mother, but only of the offspring, also the lenses of males were unaffected. I believe this is a point of great significance in the study of the effect of lens antigen.

It will also be noted that Guyer and Smith believe that the absorbing effect was possible because of the presence of blood vessels in the embryonic lens, whereas in the senile cataract case poor nutrition of the lens associated with poor lymphatic circulation is partly responsible for cataractous changes. If this is true how can we hope for liquefaction of a senile cataract by the same process as resulted in the liquefaction of the embryonic lens? It will also be noted that they report in several cases that the lens became cloudy and opaque (the result of cytolysin and precipitation). This is of course the reverse of what we are striving for, but it may be a very important point.

Two years later Guyer and Smith had carried their work along so that they report in the *Journal of Experimental Zoology* that the defects found in the eyes of their rabbits were carried to the sixth generation by breeding, and the feel that the evidence established a clean cut case of inheritance of specific modification produced by extrinsic factors.

They are not sure that the result should be reckoned as an example of the inheritance of a somatic modification; that is a change produced in the lens of the intrinsic young which in turn has induced a change in the lens producing constituents in the germ cells of these young, or a simultaneous change in the eye and in the germ cells of the young.

A noteworthy fact was that once the defects were established without subsequent treatment they became more and more pronounced in successive generations. Lens antigen would seem then to have a cumulative action. The presence of isolysins can be proved by the precipitation test. These once established in the embryonic circulation should be as effective in modifying germinal factors as corresponding anti-bodies introduced into the embryo through the placenta of the mother.

I have gone over this work in some detail as it is the basis of Dr. A. E. Davis' treatment of cataract with serum. That is he believes that a solution of emulsified lens of an animal injected into the human will cause the active formation of

anti-bodies which will seek out the lens and invade it and cause the absorption of its opacities. He lays no claim, I believe, that it will actually absorb normal lens substance. Why these anti-bodies engendered by injected normal lens substance should act on abnormal lens protein has never to my knowledge been explained. If the work of Guyer and Smith is correct, then we should rather expect no effect on the lens of the patient but rather if it were a female that her children would be born into this world with varying types of eye defects, and lenses in different stages of opacification and absorption. Let us hope that Guyer and Smith are wrong or that the patients of my lens protein clinic are all beyond the child bearing period.

The patients were selected from the clinics of Dr. John M. Wheeler at Bellevue Medical School and Bellevue Hospital, and the New York Eye and Ear Infirmary. We endeavored to select cases of all types of cataract and not limit ourselves to one particular form, and attempted to determine whether or not any particular group of cases yielded to treatment better than others. It is my understanding that Dr. Davis now advised the use of lens antigen only in incipient senile cataract where the vision is $\frac{4}{8}$ or better.

Now it appears to any one that has had any experience with cataract formation (and all authorities are agreed on this point, at least) that cataracts may appear and then grow slowly or rapidly or may become stationary all depending upon conditions of which we have but little knowledge but probably due to varying metabolic changes. Now it is very easy to delude one's self in endeavoring to effect a cure of any disease, and medical history is filled with these delusions; even the great Koch and Pasteur were not immune from the flights of their own imaginations and assumed that they had conquered disease, and found the cure, only to have their fond dreams end in ignominious defeat. Sincere they were, but their failure to keep their feet on the solid rock of scientific fact brought them heartaches, and in the case of Koch, nearly ruined the good work previously done and on which his fame today rests. So it is in the search for a cure for cararact. The eye is so sensitive to any change of vision, that one should be ever alert as to apparent effects of treatment, and not be mislead by the patient's optimism or desire for relief.

Certain it is that given a person with cataract of any origin, and a realization that vision is diminishing and the knowledge that it may go on to blindness, we will find that person most susceptible to treatment if the treatment is given with little pain and through that magic instrument, the hypodermic syringe.

Before starting the treatment of these cases, I conferred with Dr. Davis, and followed directions given by him. The patients were instructed to be abstemious regarding the use of alchohol and tobacco. They were told to drink three extra glasses of water daily, and to eat meat only once a day and then in moderation. They were given 10*cc* of potassium iodide three times a day by mouth. On the first day one minim of lens antigen was injected intracutaneously, and on the following day the site of the injection was examined to determine the amount of severity of the reaction. They were then injected subcutaneously with ½*cc* of lens antigen. The following day they were given 1*cc*. The injection was increased 1*cc* per day until 10*cc* were reached. Some of the cases were run up as high as 15 or 18*cc* per injection. The injections were given daily except on Sundays.

As some of the cases treated by lens antigen showed a stationary condition or very slow progress of the cataract, which might or might not be claimed to be due to the treatment which the cases received, it seemed wise to study a group of cases which have had no treatment whatever, either internal medication, drops or injections which also show a stationary action on the part of the cataract. In some of these cases there appeared to be a slight improvement in vision. This I believe is not due to the absorption of lens opacities but more apt to be due to either a better refraction at a later date, or else due to the fact that as the patient became more accustomed to the doctor there was better co-operation between the patient and the examiner. I am sure anyone doing a great deal of refraction on cases with lens opacities appreciates the fact that the mental attitude of the patient has a great deal to do with the vision which the patient has. It will also be noted that in some cases the opacities in one eye developed more rapidly than those in the other, although in all of the cases selected the growth of the cataract was slow. I present these cases to

confirm a well established ophthalmological fact that some cataracts do become stationary and do not go on to maturity over a long period. This fact has been so well established I am sure in the minds of ophthalmologists that I hesitate to present these cases.

I present fourteen control cases all of which show in one or both eyes lens opacities which were stationary under observation for several years.

The patients that were treated were told that we were experimenting with a substance which we have every reason to believe would cure them of their cataracts and that it would not be necessary to operate. They were told, however, that in case the treatment failed to give them the desired relief, they would still have operative procedure to fall back upon. I believe we succeeded in convincing most of the cases that we really believed that the treatment would cure them. We did this in order to obtain the best possible co-operation on the part of the patient and also to have the advantage of any psychological effect. Most of the patients co-operated extremely well. Only one case in the series developed anaphylactic shock from the injections. I believe that this was a true anaphylactic shock, as it came on at the end of the thirtieth treatment. The patient was unconscious for five or six minutes but later responded to an injection of adrenalin. About one-fourth of the cases developed a mild dermatitis at the seat of the injection and complained a great deal about the itching accompanying the dermatitis. The area at the seat of the injection in these cases was raised and had an elevated temperature. These skin reactions were of various sizes and shapes and varied greatly in severity. No inflammatory reaction of the eyes was noted in any of the patients treated.

Summary

Types of cataracts treated.	Traumatic	2
	Cortical	15
	Sclerosed Nucleus	5
	Diabetic	4
	Complicating Glaucoma	1
	Total	27

Cases which showed progress of the cataract—14.

Cases which showed no change in the progress of the cataract —13.

Cases which showed absorption of the cataract by slit-lamp examination or improvement in vision — None.

Practically all of the cases noted a general tonic effect from the lens protein.

DIPHTHERIA ANTITOXIN IN LARGE DOSES FOR SYMPATHETIC OPHTHALMIA.[1]

By Dr. EDWARD B. HECKEL, Pittsburgh, Pa.

(From the Service of the Allegheny General Hospital, Pittsburgh, Pa.)

THE term sympathetic ophthalmia is used for want of a more descriptive one. So-called sympathetic disease of the eye may manifest itself as an anterior general uveitis, with more or less occlusion of the pupillary space, or as a posterior uveitis, perhaps better described as a neuro-retinitis. In the latter type the anterior segment of the eyeball is only partly involved, the pupillary space remains quite clear and an ophthalmoscopic examination of the interior of the eye and of the fundus is still possible.

The diagnosis in each of the following cases appears well established, in each case the condition followed an injury in previously healthy normal eyes. Two of the cases are of the posterior or neuro-retinitis type and two of the anterior uveitis type with occlusion of the pupillary space. The first case is reported with the kind permission of Dr. W. H. Turner of Pittsburgh.

Case 1.—E. H., 28 years old, was injured by a bomb explosion in the Farmers' Savings Bank of Pittsburgh on August 24, 1926. The patient was seen by Dr. Turner a few hours after the accident, when examination showed a perforating wound of the right eyeball, about 5*mm* long, parallel with the cornea on the temporal side and directly

[1] Read before the American Ophthalmological Society at Quebec, Canada, June 29, 1927.

According to the suggestions of Dr. F. H. Verhoeff before the American Ophthalmological Society in 1926.

through the ciliary body. The patient was given 1500 units of tetanus antitoxin. The superficial structures were sutured and an effort was made to save the eyeball. The left eye was uninjured and negative, with normal vision. Two weeks after the injury it was my privilege to see this patient with Dr. Turner. The eyeball remained irritated with an iridocyclitis, tender and painful, with vision reduced to light perception, in short it bore all the ear marks of an eye with a retained foreign body, enucleation was advised and done, the left eye still negative in all respects. The enucleated eyeball contained a small piece of glass about as large as a grain of wheat. There was an uneventful healing of the socket.

Twenty-eight days after the enucleation of the injured right eyeball, or six weeks after the injury, this patient complained of some pain over the left temple and in the left eye. The eye *per se* was negative in appearance. Thinking it might be the result of an accommodative strain Dr. Turner refracted this left eye under homatropin cycloplegia only to find an emmetropic eye with negative fundus and visual acuity of $\frac{20}{20}$. The pain continued, but without any external evidence, for several days, when she complained of a blurring in her vision and in the course of a few days the vision was reduced to $\frac{6}{200}$. Ophthalmoscopic examination showed an edema of the retina and a blurring of the optic disc and presented the picture of a well defined neuroretinitis. A blood Wassermann was negative, teeth, tonsils and accessory sinuses were carefully gone over, including a careful study of her cardio-vascular system, but all were negative. She was given massive doses of salicylates but without any improvement. At this time about thirty days after the enucleation it was my privilege to see her again with Dr. Turner. Examination showed a well defined neuro-retinitis with a few tabs of proliferating iris tissue projecting from the under surface of the iris at the pupillary edge. There were a number of small spots on the anterior segment of the lens. Vision was reduced to fingers at four feet. The administration of a foreign protein was discussed, that of anti-typhoid serum and diphtheria antitoxin, the latter was decided upon and given in 3000 unit doses (this was before we were familiar with Dr. Verhoeff's suggestion of massive doses.) This patient was given five doses of 3000 units each of diphtheria antitoxin with very decided improvement in the vision. On November 21, 1926, or three months after the injury and about six weeks after the demonstrated appearance of the sympathetic condition the vision of the left eye or sympathizing eye was $\frac{20}{15}$. The patient was last seen on June 6,

1927, with vision still the same. The local treatment throughout was atropine and dionin.

CASE 2.—Edward B., 19 years old, had his left eye injured by a flying piece of steel while at work on August 15, 1921. He entered the hospital and was seen the same day. Examination showed the left upper lid split open vertically. The eyeball was also split vertically through the entire width of the cornea, the iris, lens and into the vitreous. The right eye was negative.

The left eye was hopeless, an enucleation was advised, and strongly urged and the danger to the other eye emphasized, to the patient and his parents, enucleation however, was refused by the patient and the parents. He left the hospital on August 26th or eleven days after the injury. He went elsewhere for treatment and finally had the injured eyeball removed on September 17th or about five weeks after the injury. He returned for our observation and treatment on December 17, 1921, or four months after the injury. Examination at this time showed a well marked neuro-retinitis with a fluid vitreous and some lens opacities, and vision reduced to $\frac{1}{200}$. Locally, atropin and dionin was used. He was given seven intravenous injections of neo-salvarsan, 0.3 grams, at intervals of several days. On February 18, 1922, his vision had risen to $\frac{2}{60}$. He then became an ambulant patient and was given mercury bichloride in an aqueous solution by mouth; improvement continued. On June 26, 1922 his vision was $\frac{4}{60}$. In August, 1922 vision was again reduced to $\frac{2}{60}$; nothing was seen of him then until June, 1926 when he returned with vision reduced to $\frac{3}{200}$. Examination at this time showed the fundus hazy and edematous and a distinct neuroretinitis. He was then again placed on mercury bichloride internally and atropine locally, but the vision gradually dropped to $\frac{1}{200}$. He was rather a careless patient but we finally had him enter the hospital in December, 1926. On December 7th he was given 1500 units of diphtheria antitoxin, on December 8th he received 3000 units, on December 10th, 3000 units and again on December 18th and 21st. His condition remained about the same with slight improvement in vision. At this time he developed a cold and the diphtheria antitoxin was temporarily omitted. On January 4, 1927 he was given 20,000 units of diphtheria antitoxin and this was repeated daily for four days. On January 10, 1927 examination showed that the fundus was decidedly clearer and vision had improved so that he could read the smaller headlines of a newspaper and distant vision was $\frac{1}{200}$. He returned to work for a short time in

April, acting as a watchman about the outside of the plant. He was last seen on June 8, 1927 with vision still at $\frac{20}{200}$. During this time he had been getting mercury bichloride gr. $\frac{1}{24}$, by mouth three times daily. Several blood Wassermanns were made but all were negative. In the meantime he has increased in weight and general well-being.

CASE 3.—M. C. V., 6 years old, was first seen on June 21, 1925. The left eye was injured by an iron rod on August 9, 1924, producing a penetrating wound of the eyeball. Examination showed the right eye with a well established general anterior uveitis, with occlusion of the pupillary space and tension slightly reduced. Left eye showed evidence of a penetrating wound through the ciliary body in the lower inner quadrant with a contracting depressed scar, and a general phthisis bulbi, more or less painful and tender to the touch. An enucleation of the offending eye was suggested but this was at first refused by the parents. It was finally done, five months after the patient was first seen, November 6, 1925 or fifteen months after the injury. During this time atropine was used locally and mercury and salicylates used internally. Her weight increased from fifty-two pounds in June, 1926 to sixty-six pounds in December, 1926, her general well-being was greatly improved and her vision became sufficient to enable her to enter school September, 1926. In March, 1927 we sent her to the hospital for diphtheria antitoxin treatment, she was given 5000 units daily, beginning on March 28, 1927 to April 7, 1927, or ten injections. At present her general health is better. The remaining eye is quiet and pale, the iris has a better color and the tension is about normal. Ophthalmoscopic examination shows a fundus reflex and transillumination shows the exudate in the occluded pupil is very much thinner. It is difficult, almost impossible, at present to elicit with any degree of accuracy the amount of vision in this eye, but it may be sufficient to state that she goes about alone and is able to read her school primer.

CASE 4.—J. B., 11 years old, was first seen on April 12, 1916. The following history was obtained: "While walking on the street April 9th, something struck him in the left eye." Examination showed a small penetrating wound at the limbus at the five o'clock point, otherwise the eye was pale and quiet. The prolapsed iris was excised and ammonium salicylate used internally, and atropine locally. But the eye remained irritated, with a mild iridocyclitis, so that an enucleation was suggested as a precautionary measure.

This was refused by the parents and the patient was taken from the hospital. On June 16, 1917, fourteen months after the injury he was brought back with a well marked anterior uveitis of each eye, with the occlusion of the pupils. The usual treatment of salicylates and atropine was used. The improvement was fairly good, the eyes became pale and quiet but the exudate in the pupillary spaces remained. Right vision was $\frac{1}{100}$ and left vision was reduced to light perception. On January 8, 1927 he returned and was placed in the hospital for observation and treatment. He was then given 20,000 units of diphtheria antitoxin daily from January 10th to January 14th, inclusive. He was given 20,000 units on January 15th and 16th, so that in all he received seven doses of 20,000 units each. The patient left the hospital on January 18th physically normal and vision of the right eye $\frac{6}{100}$. He was last seen February 28, 1927, when the vision of the right eye was $\frac{6}{100}$ and the vision of the left eye was light perception.

Routine laboratory tests were made in all these cases with negative results.

Tetanus antitoxin was given in the first case only; for some time, however, it has been our custom to give all patients with a penetrating wound of the eyeball 1500 units of tetanus antitoxin as soon as they enter the hospital.

These observations are offered without comment but with the hope that eventually they may be of some help in formulating something definite.

COMPARATIVE CHEMICAL STUDIES OF THE OCULAR FLUIDS, OF CEREBROSPINAL FLUID, AND OF THE BLOOD.

By Dr. MARTIN COHEN, Dr. JOHN A. KILLIAN, and MILDRED KAMNER, New York.

(From the Department of Ophthalmology and the Department of the Laboratories, New York Post-Graduate Medical School and Hospital.)

A SOLUTION of many of the problems confronting the ophthalmologist requires a better understanding of the mechanism of the origin of the intraocular fluids, and of their relation to other body fluids. Duke-Elder (1) has reviewed the theories proposed to explain the source of the intraocular fluids in the light of experimental data bearing upon the comparative chemical composition of the aqueous humor, and blood plasma or serum. The conclusion reached is that the intraocular fluids are a simple dialysate of the capillary plasma, the dialysing membrane being the capillary walls. Although some authorities (2) have considered the cerebrospinal fluid to be a secretion, Pincus and Kramer (3) have concluded from their studies upon the equilibrium between the concentrations of cations and anions in this fluid and in the blood serum, that the principles of the Donnan membrane equilibrium play an important part in regulating the composition of the cerebrospinal fluid. If the intraocular fluids, and the cerebrospinal fluid are to be regarded as dialysates of the blood, a similarity in their chemical composition is to be expected. In many particulars a close analogy in the structure of the ocular fluids and cerebrospinal fluid has been observed. Jess (4) has reported analogous analytical data for the ocular fluids and spinal fluid. Data were presented in a previous communication (5) for specific gravity,

total solids, proteins, and nonprotein nitrogenous compounds for the aqueous and vitreous humors and spinal fluid. These results demonstrate a similarity in composition, and suggest a possible common mode of origin.

In the preliminary analytical studies reported about a year ago, variations were noted in the concentration of some of the inorganic constituents of the ocular fluids, and of cerebrospinal fluid. The cerebrospinal fluid was drawn from human subjects, whereas the ocular fluids were obtained from animals. However, it did not seem reasonable to attribute the observed variations to the fact that the fluids were from different types of animals, since in the blood of both man and animals the inorganic constituents are remarkably constant.

The object of the work, which furnishes the basis of this report, was to make comparative studies of the total molar concentration, and the concentration of some of the inorganic constituents in the aqueous humor, vitreous filtrate and of the cerebrospinal fluid of the ox. The procedure followed in the collection of aqueous and vitreous humors has been previously described. The cerebrospinal fluid was drawn from the cervical spine immediately after the animal had been slaughtered by cutting the throat, and while the animal was suspended head downward. Ocular fluids and cerebrospinal fluids were examined at once. Only specimens of cerebrospinal fluid free from blood were used in analyses.

The presence of a solute in a solvent depresses the freezing point of the solvent. Raoult has established the fact that equimolecular amounts of different solutes depress the freezing point of a solvent to the same extent. However, if electrolytic dissociation occurs the freezing point depression is greater than the expected value. On the basis of thermodynamics Van't Hoff deduced the law that the osmotic pressure of solutions is proportional to the molar concentration. Electrolytic dissociation produces an osmotic pressure greater than the theoretical, but dependent upon the degree of dissociation. We have no desire to enter here into a discussion of osmotic pressure; this subject has been reviewed by Findlay (6). However, both the molar concentration and the osmotic pressure of solutions can be calculated from the observed depression of the freezing point (8).

TABLE I.

OSMOTIC PRESSURE AND MOLAR CONCENTRATION OF AQUEOUS HUMOR, VITREOUS FILTRATE AND CEREBROSPINAL FLUID OF OXEN.

AQUEOUS HUMOR			VITREOUS FILTRATE			CEREBROSPINAL FLUID		
Freezing point depression °C.	*Osmotic pressure at 37°C.*	*Molar solution at 37°C.*	*Freezing point depression °C.*	*Osmotic pressure at 37°C.*	*Molar solution at 37°C.*	*Freezing point depression °C.*	*Osmotic pressure at 37°C.*	*Molar solution at 37°C.*
−0.5994	8.19	0.3656	−0.5713	7.81	0.3486	−0.5353	7.32	0.3267
−0.5982	8.17	0.3647	−0.5627	7.69	0.3433	−0.5413	7.40	0.3303
−0.5570	7.63	0.3406	−0.5492	7.51	0.3352	−0.5829	7.97	0.3558
−0.5490	7.50	0.3348	−0.5459	7.46	0.3330			
−0.5508	7.53	0.3361	−0.5448	7.45	0.3325			
−0.5666	7.74	0.3455	−0.5722	7.82	0.3491			
−0.5455	7.45	0.3325	−0.5480	7.45	0.3325			
−0.5580	7.63	0.3406	−0.5505	7.52	0.3357			
−0.5650	7.72	0.3446	−0.5410	7.39	0.3299			
Average			Average			Average		
−0.5659 °C.	7.72	0.3446M	−0.5539 °C.	7.55	0.3370M	−0.5531 °C.	7.56	0.3375M

The osmotic pressure is expressed in atmospheres.

The depression of the freezing point (reported in Table I) has been determined in 9 specimens of vitreous filtrate, in 9 specimens of aqueous humor and 3 specimens of cerebrospinal fluid of oxen. The Beckmann (7) apparatus with a standardized thermometer was utilized. Fluids from a number of animals were pooled to afford enough material for analysis (15*cc*). Fresh specimens only were utilized in these studies. No attempt was made in the collection of the fluids to prevent contact with air. Dissolved gases, such as CO_2 may have escaped. Consequently the figures reported do not represent the true osmotic pressures of these fluids in the living organism. However, the figures are indices of the molar concentrations of the fluids examined.

The mean value for the osmotic pressure of the nine specimens of aqueous humor examined was 7.6 atmospheres. The deviations of the individual determinations from the mean ranged from − 0.3 to + 0.5 atmospheres. For the three specimens of cerebrospinal fluid, the average osmotic pressure was 7.4 atmospheres, with deviations from − 0.2 to + 0.5 atmospheres. More uniform results were obtained for the vitreous filtrate. Here the mean value was 7.4 atmospheres, the maximum variations from this being − 0.1 to + 0.2

atmospheres. With the cryoscopic method Osborne (9) has found the aqueous humor isotonic with the blood serum in the ox. Duke-Elder (1) in experiments on the aqueous humor and blood plasma of the same animal (rabbit) has noted an osmotic pressure of the aqueous less than that of the blood plasma, and corresponding to that of a dialysate of the blood in the arterial capillaries. Findlay (6) has observed fluctuations in the osmotic pressure of the blood throughout the day in response to the partaking of food. It appears probable that the variations noted in Table I for the aqueous and cerebrospinal fluid may be dependent upon corresponding changes in the bloods of these animals. Apart from the insignificant variations noted, the average figures for the osmotic pressure of the aqueous humor, vitreous filtrate and cerebrospinal fluid indicate that these fluids have similar molar concentrations. Jess (4), also using the same method, reports identical osmotic pressures for the aqueous and vitreous humors.

Molar concentrations of solutions may be calculated from the observed depression of the freezing point on the basis of the fact that the presence of 0.1 gram molecule of a solute in one liter of water lowers the freezing point of the water − 0.186°C. Moreover, such a solution would have an osmotic pressure of 2.24 atmospheres. Identical values, 0.297M, have been obtained for the cerebrospinal fluid and vitreous filtrate. For the aqueous humor a slightly higher figure, 0.304M, was found. This difference of 0.007M is without significance since it is not greater than the variations of the individual determinations from the mean values for any of the fluids.

The problem presented to the biochemist is the explanation of the fact that, although these three fluids have practically identical molar concentrations, and in most respects a similar chemical composition, the vitreous filtrate possesses a distinctly greater viscosity. Cavazzani (10), Scalinci (11) and Dieter (12) have found for the aqueous humor a slightly greater transpiration time than for water. For the vitreous, compared to water, Cavazzani has reported a transpiration time in the ratio of 1.376 to 1.0. The absolute viscosity of blood serum, vitreous filtrate, aqueous humor, cerebro-

spinal fluid of the ox, and of water have been determined with the Ostwald viscometer. The viscosity has been expressed in C.G.S. units, *i.e.*, the force required to move 1 gram of the fluid through a distance of 1*cm* during 1 second. To simplify the expression of the results in Table II and the

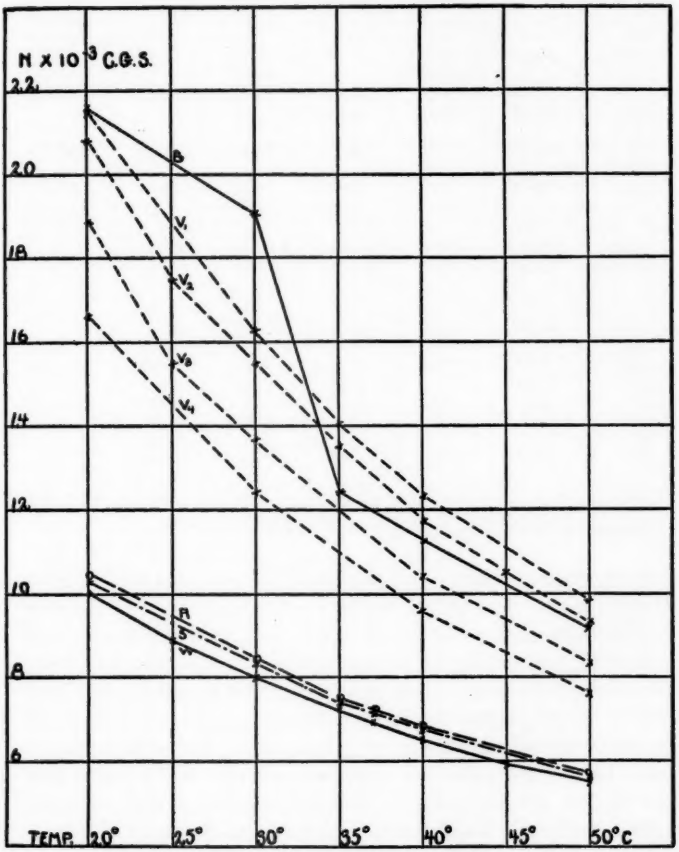

CHART 1.—Graphs for the viscosities of blood serum, vitreous filtrates, aqueous humors and cerebrospinal fluids at temperatures varying from 20°C. to 50°C. B — blood serum, V_1 — V_2 — V_3 and V_4 — vitreous filtrates, A — aqueous humor, S — cerebrospinal fluid and W — water.

TABLE II.

VISCOSITY OF BLOOD SERUM, VITREOUS FILTRATE, AQUEOUS HUMOR AND SPINAL FLUID.

Temperature	*Blood serum*	*Vitreous filtrate*	*Vitreous filtrate*	*Vitreous filtrate*	*Vitreous filtrate*	*Vitreous filtrate*
20°C.	19.58	20.85	21.50	18.87	19.16	16.62
25		17.48		15.49		
30	17.11	15.46	16.33	13.63	13.83	12.46
35	12.42	13.51	14.00			
37						
40	11.28	11.76	12.35	10.46	10.95	9.60
45		10.50				
50	9.22	9.27	9.83	8.37	9.11	7.58

Temperature	*Spinal fluid*	*Spinal fluid*	*Aqueous humor*	*Aqueous humor*	*Water*	
20°C.	10.18	10.40	10.57	10.42	10.05	
25					8.93	
30	8.23	8.39	8.31	8.29	8.00	
35	7.44		7.45	7.47	7.22	
37	7.20	7.34	6.81		6.94	
40	6.79			6.79	6.56	
45					5.98	
50	5.61	6.39	5.73	5.78	5.49	

Viscosity expressed in C.G.S. units = NX 10^{-3}.
Figures in the table represent the value of N.

construction of Chart I, the viscosities are reported as $N \times 10^{-3}$ C.G.S. units. The values for N, for the four fluids at varying temperatures are given in Table II. In Chart I, the ordinates represent the values of N, and along the abscissæ the temperature is plotted. Data are given for 1 specimen of blood serum, 5 specimens of vitreous filtrate, 2 specimens both of aqueous humor and of cerebrospinal fluid. Individual graphs have been drawn for the specimens of vitreous filtrate, but the figures for the samples of aqueous humor and cerebrospinal fluid were so close that only one mean curve for each of these fluids could be represented.

With an increase in temperature there is noted a decrease in viscosity of all the fluids. Aqueous humor and cerebrospinal fluid have viscosities slightly greater than water, and with

rising temperature, their curves decline parallel with that for water. At 20°C. considerable variation is noted in the viscosities of the different specimens of vitreous fluid, ranging from 16.62 to 21.50 × 10^{-3} C.G.S. At this temperature, specimens of vitreous filtrate have viscosities slightly less than the blood serum. The curves, however, for rising temperature are parallel, dropping to from 7.58 to 9.83 × 10^{-3} C.G.S. For all of the fluids examined, the value of N at 50°C. is approximately one-half of its value at 20°C. It is evident from the data of Table II and the chart that the viscosity of the vitreous filtrate approximates the viscosity of blood serum. In blood serum, it is believed that the viscosity is a function principally of the protein concentration. Blood serum contains 200 times more protein than the vitreous filtrate; moreover the vitreous filtrate has a protein content comparable with that of the aqueous humor and of the cerebrospinal fluid. Hence, the protein content of these fluids cannot be the sole factor determining their viscosity. This question will be discussed in greater detail in a future communication.

TABLE III.

CALCIUM CONCENTRATION OF THE CEREBROSPINAL FLUID, VITREOUS FILTRATE AND AQUEOUS HUMOR OF OXEN EYES.

Calcium mg. per 100*cc.*

Vitreous filtrate	*Aqueous humor*	*Cerebrospinal fluid*
7.6	7.6	6.4
7.5	8.1	5.4
8.4	8.3	4.9
7.8	6.7	5.7
7.9	7.3	4.3
7.8	7.1	4.7
7.5	6.9	
7.9		
8.6		
8.5		
7.8		
verage 7.9	7.4	5.3

Data on the calcium content of the vitreous filtrate, aqueous humor and of the cerebrospinal fluid are presented in Table III. These determinations were made upon individual specimens of these fluids, but the three fluids were not obtained from the same animals. The Clark-Collip (13) modification of the Kramer-Tisdall method was utilized for the calcium determinations. The average for eleven analyses of calcium in the vitreous filtrate was 7.9*mg* per 100*cc*. For seven specimens of aqueous humor, an average of 7.4*mg* per 100*cc* was obtained, but in six specimens of cerebrospinal fluid, an average of 5.3*mg* of calcium per 100*cc* was found. The figures for the calcium content of the vitreous filtrate and aqueous humor of oxen eyes correspond with the data reported by Cohen, Killian and Metzger for the fluids of horses' and pigs' eyes. Duke–Elder, however, has found only 6.2*mg* of calcium per 100*cc* of horses' aqueous, forming 62 per cent. of the blood serum calcium. In Duke-Elder's analyses, the ocular fluids and blood serum were not obtained from the same animal and apparently the calcium was determined in the ash by converting the calcium exalate precipitate into calcium oxide. Such an analytical procedure may give lower results than the precipitation of the calcium directly in the fluid, as in the Clark-Collip procedure.

Cameron and Moorehouse (14) report a mean of 5.8*mg* per 100*cc* for the calcium of cerebrospinal fluid, and 11.1 for the calcium of the blood serum of twenty normal dogs. In this series, the cerebrospinal fluid calcium was 53 per cent. of the blood serum calcium. Comparative studies have been made in this laboratory of the calcium of the blood serum and cerebrospinal fluid drawn simultaneously in nineteen human subjects. An average of 10.94*mg* was noted for blood serum, and 5.68 for the cerebrospinal fluid (15). The calcium of the cerebrospinal fluid was 51.6 per cent. of the blood serum calcium. Halverson and Bergeim (20) have determined the calcium of the cerebrospinal fluid in nineteen cases, obtaining figures varying from 5.0 to 5.3*mg*, and an average of 5.1*mg* per 100*cc*. In the cerebrospinal fluid from four normal individuals, Kummer and Minkoff (21) obtained results from 5.0 to 5.2*mg* per 100*cc*. Critchley and O'Flynn (22) have established as the normal calcium content of the cerebro-

spinal fluid, 6.2*mg* per 100*cc* as a result of the study of 115 fluids.

In Table III, the figures for the calcium of the cerebrospinal fluid of the horse agree with the data of Cameron and Moorehouse for dogs, and results in the literature for human subjects. The deviations of the individual figures from the mean are not greater than those reported by Cameron and Moorehouse. From the results reported in Table III, the conclusion appears warranted that the calcium concentration of the vitreous filtrate and of the aqueous humor is greater than that of the cerebrospinal fluid.

TABLE IV.

RELATION OF THE CALCIUM OF THE OCULAR FLUIDS TO THE BLOOD SERUM CALCIUM.

Experiment	*Blood serum calcium mg. per 100cc serum*	*Ocular fluid calcium mg. per 100cc fluid*	CALCIUM-OCULAR FLUID *Blood serum calcium*
Rabbit 1.....	11.4	8.4	0.73
Rabbit 2.....	10.9	7.4	0.67
Rabbit 3.....	11.2	8.0	0.71
Rabbit 4.....	11.5	8.0	0.69
Rabbit 5.....	12.7	8.5	0.66
Rabbit 6.....	12.1	9.0	0.74
Average.....	11.6	8.2	0.70

Since the data of Table III demonstrate a distinction between the calcium concentration of the ocular fluids and that of the cerebrospinal fluid, it appeared desirable to determine the relation of the calcium of the ocular fluids to the blood serum calcium in the same animals. Six large, healthy rabbits were anesthetized with ether, and bled to death after enucleation of the eyes. Blood for analysis was obtained from the ophthalmic arteries. The aqueous and vitreous humors from both eyes of each animal were combined and filtered to afford enough material for analysis (2*cc*). This combination of the aqueous and vitreous humor throughout this paper is

called "ocular fluids." In the blood serum of these rabbits, the calcium content varied from 10.9 to 12.7*mg*, and in the ocular fluids from 7.4 to 9.0*mg*.

TABLE V.

COMPARATIVE CONCENTRATION OF SOME INORGANIC COMPOUNDS IN VITREOUS FILTRATE, AQUEOUS HUMOR AND CEREBROSPINAL FLUID OF OXEN.

Constituent	*Vitreous filtrate mg per 100cc*	*Aqueous humor mg per 100cc*	*Cerebrospinal fluid mg per 100cc*
Chlorine	411	417	444
Chlorides as NaCl	678	688	732
Sodium	301	316	340
Potassium	24.9	20.0	19.5
Inorganic phosphorus	2.2	4.2	1.6

In Table V data are given for several of the inorganic constituents of the vitreous filtrate, aqueous humor and cerebrospinal fluid of oxen. Since the specimens for analysis were not obtained from the same animals, and the data presented are mean figures for many analyses, slight difference in concentrations must be overlooked. For chlorine determinations, Van Slyke's (16) technic has been utilized. Assuming that the chlorides were wholly in the form of sodium chloride, the chloride concentration as sodium chloride has been calculated from the chlorine figure. Sodium was determined according to the method of Kramer and Gittleman (17), and potassium by that of Kramer and Tisdall (18). The technic of Benedict (19) was followed in the analyses for inorganic phosphorus.

Pincus and Kramer have reported a study of the inorganic constituents of the cerebrospinal fluid of three normal individuals. The data for oxen spinal fluid in Tables III and V are in close agreement with the results obtained by these authors for human cerebrospinal fluid. A study of the figures presented in Table V demonstrates some differences, we believe significant, in the composition of the ocular fluids and of the cerebrospinal fluid. The average figures for chlorides

and sodium of the cerebrospinal fluid are greater than the corresponding figures for aqueous humor or vitreous filtrate. However, the ocular fluids contain more potassium and inorganic phosphorus than does cerebrospinal fluid. Some differences are also noted in the composition of the ocular fluids themselves. In the aqueous humor, the concentration of chlorides, sodium and inorganic phosphorus exceeds the concentration of these components in the vitreous filtrate, but more potassium is found in the vitreous filtrate than in the aqueous humor.

In the analysis of biological material by micro methods due allowance must be made for probable experimental errors before any significance is attributed to slight variations in mean figures. However, the ocular fluids and cerebrospinal fluid are very similar in their physical and chemical properties, and all other things being equal, the application of the analytical methods to these fluids would entail errors of similar magnitude and of the same order. Moreover, the fact that Cohen, Killian and Metzger, in previously reported results, noted analogous differences in the composition of the aqueous humor and vitreous filtrate of oxen and horses' eyes, suggests that these differences noted in Table V are real and not analytical artifacts. If the ocular fluids and cerebrospinal fluid arise from the blood plasma solely by a physical process of dialysation, it is to be expected that the three fluids as dialysates should contain analogous concentrations of cations and anions. Our data indicate that the distribution of both cations and anions among the three fluids is not uniform. Both the aqueous humor and the vitreous filtrate contain more calcium than does the spinal fluid. Duke-Elder has reported finding 6.2*mg* of calcium per 100*cc* of aqueous humor, a concentration of calcium representing 62 per cent. of the blood serum calcium. This distribution of calcium between blood serum and aqueous humor does not agree with any of the reliable data for the distribution of calcium between blood serum and cerebrospinal fluid. Further, the inorganic phosphorus of the ocular fluids exceeds that of the cerebrospinal fluid. This observation is corroborated by Duke-Elder's finding of 3.3*mg* of inorganic phosphorus per 100*cc* of aqueous humor, whereas about one-half of this amount of inorganic phosphorus has been reported for cerebro-

spinal fluid (Table V and Pincus and Kramer, and Cohen). The lack of uniformity in the concentration of cations and anions among these three fluids makes it doubtful whether we can explain the origin of all of these fluids by a simple physical process of dialysation from the blood plasma, unless we postulate a difference in the permeability of the separating membranes. The problem of the origin of the intraocular fluids cannot be solved by a study alone of the distribution of electrolytes between the blood plasma and these fluids. Data on the distribution of diffusible non-electrolytes (anabolins and catabolins) between the blood and ocular fluids will be presented in a subsequent communication.

Summary.

Aqueous humor, vitreous filtrate and cerebrospinal fluid of the ox have similar freezing point depressions and osmotic pressures. Hence molar concentrations of these fluids are similar, varying from 0.297 to 0.304M.

The absolute viscosities of these fluids have been determined for varying temperatures. Although the blood serum contains 200 times more protein than the vitreous filtrate, the viscosity of the vitreous filtrate approximates that of blood serum. The viscosities of cerebrospinal fluid and aqueous are identical, being slightly above that of water. All fluids show parallel decreases in viscosity with rising temperature.

More chlorine and sodium have been found in the cerebrospinal fluid than in aqueous or vitreous humors. The potassium content of the vitreous filtrate exceeds that of the aqueous humor and cerebrospinal fluid. The amount of inorganic phosphorus in the aqueous is greater than the amounts found in vitreous filtrate or in cerebrospinal fluid. The calcium concentration of the eye humors are similar, but greater than the calcium of the cerebrospinal fluid. In rabbits, the calcium concentration of the ocular fluids was 70 per cent. of that of the blood serum.

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REPORT OF THE OXFORD OPHTHALMOLOGICAL CONGRESS.

By Mr. BERNARD CRIDLAND, Honorary Secretary.

XVII Annual Meeting.

The Seventeenth Annual Meeting of the Oxford Ophthalmological Congress was held at Oxford on July 7th, 8th and 9th under the Mastership of Mr. Philip H. Adams.

The Proceedings took place in the Department of Human Anatomy through the kindness of Professor Arthur Thomson, whilst Keble College, where members met informally at dinner on the 6th was again available for hospitality.

After a brief opening at 10 A.M. by the Master a Discussion was held on **The Results of the Operative Treatment of Glaucoma.** The opener, Dr. William H. Wilmer, Opthalmologist-in-chief to the Johns Hopkins Hospital, Baltimore, began with a reference to the work of Von Graefe who in 1857 wrote concerning glaucoma "the absence of general agreement constitutes an hereditary evil of therapeutics only to be cured by slow degrees"——"The only treatment from which relief can be expected is one that diminishes pressure."

That both these propositions are true to-day is attested by the fact that over sixty operative procedures, with many modifications are on record, all of which are devised solely for the purpose of reducing intra-ocular tension.

An analysis of a few of the kinds of operations and their results as reported by various authors is as follows:

Iridectomy: 482 cases: Successful, 63.3%. No late infection mentioned.

Anterior Sclerectomy: (Lagrange), 777 cases: Successful

72.8%. Late infection (based on 289 eyes), 1.3%. Lagrange's own cases, 104: Successful 85.5%.

Sclero-Corneal Trephine (Elliott), 3381 cases, not including 911 eyes operated upon in Egypt. Successful, 77.6%. Late infection 1.2%.

Punch (Holth). Holth publishes the record of 200 cases in Christiania from 1920 to 1923. The percentage of successes is not given, but he states that there were no late infections, and concludes: "The lowering of the ocular pressure is as good as in the other forms of sclerectomy and, so far, no case of late infection has been observed."

Hagen records 52 cases operated by Holth, Hj. Schiotz, and himself. Of these he excludes 12, confining his tables to 40 cases of glaucoma simplex. Successful, 82%. Butler reports 29 cases: Successful 79.3%. Late infection 3.4%. Later, he reports 39 cases successful, 66.7%.

Iris Incarceration: 517 cases: Iridotasis and iridencleisis. Successful, 87.4%. Late infection, 0.3%.

Wedge-Isolation and *Small Flap.* Sclerotomy (Herbert). The author has given up the former operation for the small flap sclerotomy. The reports are too few to analyze. Butler quotes 7 cases (small flap). Successes, 50%, but this in no way indicates the excellent results obtained by the skilful originator himself.

Cyclodialysis (Heine), 1027 cases. Successful, 66. 7%: no serious complications mentioned.

Whilst he, the opener, employed iridectomy, anterior sclerectomy and cyclodialysis the trephine was more frequently used by him. Two series of his own trephine cases were then presented, many of which had been under his personal observation for many years.

Series I. Of these 72 eyes, 76.3% of the whole number have been under observation from 10 to 15 years: 19.4% from 5 to 10 years, and 4.1% from 3 to 5 years. Successes, 84.8%. Failures, 15.2%.

Series II. 35 cases (private and free), trephined within two years (none within four months), are reported for comparison. Successful, 91.3%. Partial failure, 5.7%. Complete failure, 2.8%. In these cases success meant a tension of 18 or under (Schiotz reading) with a maintenance or improvement of

the vision and the fields of vision as compared with that before operation.

Causes of failure were previous venous thrombosis, tuberculous deposits filling trephine openings, traumatic dislocation of lens 10 years after a successful operation, rapid development of immature cataract after hæmorrhage, and repeated retinal hæmorrhages. In nineteen of the second series of cases a Tenon's capsule implant was made use of, a valuable procedure where the conjunctival flap is too thin and as a prevention against infection.

A series of very interesting slides of the eyes of rabbits and dogs were shown, upon which anterior sclerectomy, sclerocorneal trephine, wedge isolation, small flap sclerotomy, and iridotasis had been performed.

After commenting on the various types of operation the opener said that every operator is more skilful in the performances of the operation he selects, but for the average the trephine is more safely and easily performed than the Lagrange or punch operation.

It is also suitable for more kinds of glaucoma and in eyes with very high tension. In the Lagrange operation, if the pressure is high, there is more danger of expulsion of the lens and loss of vitreous at the time of the operation or later. Few operators have the skill of the originator of the excellent operation that bears his name. When the surgeon has much operative material, so that he can perfect his technique in both the Lagrange and Elliott, the plan of several of my colleagues is practical, that is, when the tension is below 35 (Schiotz) perform an anterior sclerectomy; when above, a trephine.

Professor Felix Lagrange (Paris) who was accorded a very hearty reception, referred to the time when he performed his operation of sclerecto-iridectomy for the first time in England at the Oxford Meeting held in 1906 and commented on the cordial relationship ophthalmologically between France and England. With regard to results, he had never seen infection follow his operation.

Mr. A. L. Whitehead (Leeds) said that after trying other procedures his rule now was to perform iridectomy in case of acute glaucoma and trephining for chronic glaucoma.

An analysis of 120 of his private cases, chosen because the records were more complete than in hospital cases, was as follows:

of 38 acute cases
57.9% were successful,
26.3% partially so and 15.7% were failures.

of 14 subacute cases
85.7% were successful, 14.3% partially so and no complete failures.

of 48 chronic cases
87.5% were successful, 4.1% partially so and 8.3% failures.

Lt.-Col. H. Herbert (Brighton) considered that successful results were obtained with his flap operation especially if massage was regularly applied afterwards.

With regard to iris-inclusion he thought there should be a distinction made between disasters at the time of operation and simple failures to relieve tension, and he felt that there ought to be no danger of sympathetic ophthalmia provided that proper aseptic precautions were undertaken before the operation.

His belief was that the future lay with the small linear wounds either with or without iris inclusion.

Mr. Malcolm Hepburn (London) said that his operative experience had forced him to the conclusion that not all forms of glaucoma can be explained on the same pathological theory, but that different pathological conditions account for the various types of the disease. It followed from this that the results obtained by applying one type of operation for all forms of glaucoma would be variable and it was necessary for the surgeon in order to be successful to select the type of operation suitable for the case he had in hand.

Good results would depend upon this and upon operating early, bad results upon operating late, unsuitability of operation, mistakes in technique and secondary complications over which one had no control.

Lt.-Col. R. E. Wright, I. M. S., agreed with Dr. Wilmer in his support of trephining as opposed to cyclodialysis and

was interested in the method described by him for obtaining an extra cover of tissue over the trephine hole.

He was in favor also of a broad iridectomy in cases where he feared a "desquamation of uveal tissue" or "iritis" as it is termed. Massage was of value in all cases although there was really no necessity for this after trephine operations.

DR. C. F. BENTZEN (Copenhagen) reported the results of 72 cases of trephining in which he had separated the conjunctiva from the limbus instead of from above as in the usual Elliott method. Of the 72 cases 6 were those of buphthalmia, 4 of acute glaucoma, 14 of absolute glaucoma and 48 of chronic glaucoma. No case of late infection had occurred. There were poor results in the buphthalmia cases and also in those of absolute glaucoma.

In the acute cases the results were moderately good and in the 48 cases of chronic glaucoma there were 77% of successes.

PROFESSOR SZYMANSKI (Wilno) described his modification of Elliott's operation in which he made use of a large trephine cutting obliquely a semicircle of sclera which was then excised with scissors.

MR. HARRISON BUTLER (Birmingham) referred to the mental complications which happened in operations on elderly decrepit patients. In iridencleisis operations he had found that no result was obtained *i.e.*, neither fall of tension nor any untoward complication. After trephining, a shallow anterior chamber might follow, which if persistent led to the formation of a nuclear cataract. He had observed the fall of tension in the fellow eye after a successful operation on the one.

MR. DAVENPORT (London) referred to the analysis of some 536 cases of glaucoma, 405 being primary which had been trephined at Moorfields by various surgeons in the last 5 years. The results obtained were according to vision only.

These were reported fully in the *British Journal of Ophthalmology* of 1926. In 2 cases only of the 536 did mental disturbance occur, and there were 14 cases of late infection of which, however, only 8 were definitely in connection with the trephine hole.

DR. HARALD GJESSING (Drammen) spoke of having had 81% of good results by Holth's method, the cases having been under observation from 7 months to 11 years.

MR. J. GRAY CLEGG (Manchester) considered that detachment of the choroid was a much more frequent result than usually thought, as much in his opinion as even 10%.

MR. B. GRAVES (London) referred to cases of persistent low tension after operation, in one of which shrinking of the eye had followed.

MR. D. V. GIRI (Eastbourne) in speaking of the fluorescine test for filtration commented on the variations in tension which occurred during the day.

LT.-COL. A. E. J. LISTER (Bristol) asked for an expression of opinion on the question of low tension after operation, which he regarded as a very alarming complication.

DR. WILDER (Chicago) said that in America as all operations had been tried but that no definite conclusions had been arrived at, this was good evidence that none was perfect.

The best thing would be for one surgeon to perform all the various procedures for comparison.

He personally was in favour of the iris-inclusion operation having only had one unsatisfactory case in 100 operated on by this method. In reply Dr. Wilmer said that he had differentiated the cases with meticulous care but had left out the reading of it out of sympathy for his audience.

Expulsion of the lens after the Lagrange operation was, according to the literature, a not uncommon complication, and one such case had been recorded after a trephine operation.

He had never experienced separation of the choroid in his own practice but had seen two in consultation, both of which promptly got well.

He had had cases of very low tension after both trephining and the Lagrange operation but had never had an eye in which there was delayed formation of the anterior chamber.

In the afternoon of Thursday, after Professor F. Lagrange had read a paper on "The best procedure to adopt for fistulisation of the glaucomatous eye," demonstrations were held in the Scientific and Commercial Museums.

LT.-COL. R. E. WRIGHT, I.M.S., demonstrated Green's apparatus in intracapsular extraction of cataract, and his own method of blocking the main trunk of the facial to prevent squeezing in cataract operations.

He also showed a series of extremely interesting histo-pathological slides of orbital neoplasms.

Dr. J. Burdon-Cooper (Bath) demonstrated a new astigmatic Test Chart.

Dr. Thomas Henderson (Nottingham) demonstrated in an ox eye the membranous nature of the Ligamentum Zonulæ Lentis by injecting air through the ligaments—into the Canal of Petit thus showing that it is a closed space.

Dr. H. H. Tyson (New York) exhibited a series of skiagrams of the optic foramen showing the variations in size and shape from the normal and demonstrated the effect which the narrowing of the canal had upon the optic nerve causing atrophy.

Dr. D. V. Giri showed a photograph of a useful apparatus for red-free ophthalmoscopy and a lid-retractor which raised the lids free from the globe as well as retracting them.

Mr. F. A. Anderson (Shrewsbury) showed an excellent operating light obtained by a series of small lamps.

Mr. B. Cridland (Wolverhampton) showed the drawing with specimen and slides of a case of cholesterin crystals in the anterior chamber. The chief feature of the proceedings on the morning of Friday was the delivery of the Doyne Memorial Lecture by Professor K. K. K. Lundsgaard of Copenhagen, the subject being "The Pneumococcus in Connection with Ophthalmology."

The Lecturer showed a chart of the incidence of the pneumoccus on the normal conjunctiva as determined by various observers since 1909, the latest record being that obtained by himself in 1925, namely 6%. The various types of the micro-organism were described and charted according to their virulence.

Other charts were shown giving the incidence according to age and seasonal variation.

A very complete survey of the rôle which the pneumoccus plays in ophthalmology was given and Professor Lundsgaard, who was at the conclusion of the Lecture presented with the Doyne Memorial Medal for the year, is to be heartily congratulated on his contribution to the knowledge of the subject.

Other papers delivered on the same morning were by Dr. Carsten Edmund (Copenhagen) on "Colour Perception in

Normal and night-blind persons in Various Illuminations," by Lt.-Colonel R. E. Wright who gave a résumé of notes on a series of fifty cataract extractions with Green's apparatus by himself and K. Koman Nayer, and by Dr. Holger Ehlers on "Experimental researches on the corneal vessels."

The afternoon of Friday was spent at the Oxford Eye Hospital where a series of interesting cases were shown by the Master, Mr. P. H. Adams and by Messrs. Harrison Butler and Harries Jones. After the cases had been examined Lt.-Colonel Wright's paper given in the morning was freely discussed by Lt.-Col. Henry Smith, C.I.E., I.M.S., ret., and many others.

On the morning of Saturday papers were read in the Department of Human Anatomy as follows:

Dr. J. Burdon Cooper,
: The Permanent and Evanscent Canals of the Hyaloid Membrane with a suggestion as to their function in the drainage of the eye.

Dr. Margaret Dobson,
: Insufficiency of Accommodation is an Important Factor in the Causation of Incipient Cataract.

Dr. Harald Gjessing,
: Further investigations into the results of iridencleisis operations by Holth's method, particularly as regards the method combined with meridional iridotomy.

Mr. D. V. Giri,
: (a) An instructive case of high hyperphoria remedied by operation.
(b) A case of extreme mictography with comments on its physiological optics.

On Thursday afternoon the members of the Congress and their friends were entertained at tea at Merton College with Mr. and Mrs. de Beer kindly acting as host and hostess.

The Annual dinner of the Congress which was well attended was held in Keble Hall on Thursday evening with Professor Arthur Thomson as chief guest.

Members who attended from abroad, in addition to those already mentioned in the programme included Dr. H. Friedenwald (Baltimore) Dr. Bernard Samuels (New York), Dr. Birger Malling (Bergen), Dr. A. Verwey (Durban), Dr. R. G. Stott and Dr. A. S. Anderson (Australia) and Dr. Pandit (India).

The total membership of the Congress is now over 400 and the attendance this year was well over the average.

REPORT OF THE TRANSACTIONS OF THE OPHTHALMOLOGICAL SECTION OF THE ROYAL SOCIETY OF MEDICINE.

By Mr. H. DICKINSON, London.

The first meeting of the Section in the new session took place on Friday, October 14th, the President, Mr. Ernest Clarke, M.V.O., F.R.C.S., occupying the chair.

Paper on The Process of Retinal Differentiation in Man.

Miss Ida C. Mann, who has recently been elected to the Staff of the famous Moorfields Ophthalmic Hospital, read a contribution on this subject, and demonstrated a large number of slides by means of the epidiascope in illustration of the theme.

She first reminded members that three months previously, in Edinburgh, she read a paper dealing with the broad principles of differentiation of the retina in the lower vertebrates; her purpose on the present occasion was to show the application of these principles in detail to the human retina. The chief points she wished to show were the following: (1) the appearance of the conducting layers before the percipient ones, *i.e.*, the fibers of Müller, the ganglion cells, and the nerve fiber layers differentiated before the rods and cones; (2) the derivation of the amacrine cells from the same layer as the ganglion cells, and their secondary fusion with the bi-polar layer.

The specimens with which she illustrated the paper consisted of retina from the posterior pole, normally just above the macula. She was not proposing now to deal with the modi-

fication of the general development which took place in specialized regions, such as the macula or the ora serrata.

She said that the layers of the adult retina, from the internal limiting membrane to and including the rods and cones, were formed by proliferation and re-arrangement of the nuclei of the inner wall of the optic cup. The pigment epithelium was formed from the outer wall of the optic cup.

The changes occurring in the inner layer could be roughly divided into three periods, which, in the posterior part of the cup, corresponded, in time, with:

(1) The fourth to the fifth week;
(2) Six weeks to the third month;
(3) The third month to the seventh month.

First period.—The inner wall consisted of a nucleated zone of primitive neuro-epithelium, and an inner non-nucleated marginal zone. At the end of this period, the nuclei of the neuro-epithelium began to migrate inwards into the marginal zone, two nuclear layers being formed in this way.

Second period.—These two nuclear layers were named the inner and the outer neuroblastic layers, respectively; they were separated by a narrow interval, the transient fiber layer of Chiewitz.

Third period.—From the cells of the inner neuroblastic layer were formed, by differentiation, three types of cell: amacrine cells, ganglion cells, and supporting cells (the fibers of Müller). From the outer neuroblastic layer were also formed three types of cell: bi-polar, horizontal, and rod and cone nuclei. Towards the end of the period the transient fiber layer of Chiewitz disappeared (except at the macula, where development was retarded), and the amacrine cells and Müllerian fiber nuclei fused with the bi-polar and horizontal cells to form the inner nuclear layer. The inner and outer molecular layers appeared and separated themselves from the ganglion cells on one hand, and from the nuclei of the rods and cones on the other. Thus the adult condition was reached by about seven months in the peri-macular region.

THE PRESIDENT cordially thanked Miss Mann, in the name of the Section, for her lucid demonstration.

Clinical Cases.

MR. F. JULER showed a little girl, aged 4 years, with pterygium. When he first saw the child, a pterygium had been removed at another place, from both eyes, and she came to him with a recurrence of the condition in the left eye. This recurrence he removed by the ordinary method in July of last year, and the result of the operation seemed to be satisfactory. However, a relapse occurred later, a grosser condition than the original one he saw. He removed the further recurrence eight months ago, burying the apex under the conjunctiva below. Still a further recurrence took place, and there was now a large pterygium, getting to the pupil margin and interfering with vision. On the other cornea were one or two nebulæ, apparently the commencement of a pterygium, and he thought it likely that there was some ulceration to start with. On the other hand, the mother said that something amiss with the child's eye was noticed soon after birth. His feeling was that he ought now to see what radium would do for the condition.

COLONEL LISTER and MR. HARRISON BUTLER said they had not seen a condition like this in the many cases they saw abroad of pterygium, in, respectively, Northern India and Jerusalem.

MR. MAC CALLAN said this was the earliest example of the condition he had seen, though he had had experience of many cases of pterygium in Egypt. He dealt with them in the way Mr. Juler operated on the recurrence in this case. It was most important that conjunctiva should be left adjacent to the cornea. If the bare area was touched with pure carbolic two or three times it inhibited the growth in many cases, and prevented recurrence, which was the tendency if this was not done.

MR. PRESTON showed a case of mass in the vitreous, glioma. The patient was under the care of Mr. Greeves. The possibilities of it being glioma, tubercle, Coats' disease, or some inflammatory condition were considered. Mr. Greeves inclined to the view that it was glioma, but there was pigment on the lens.

MR. J. H. FISHER also thought it was glioma, and advised

excision of it. What evidences there were of it being inflammatory were trifling: there was no iritis nor evidence of keratitis punctata deposits, and the tension in that eye was quite equal to that in the other.

Mr. Humphry Neame reminded members of a case of which he showed the drawing, in which there was a very similar appearance, but the vessels could be seen to emanate from the central part of the eye and then to divide peripherally as they passed out over the mass towards the ciliary body, and that supported the diagnosis of glioma.

Mr. Foster Moore sent a case of new tissue formation on the cornea. The girl attended because of a white opaque patch on the limbus of the right eye. In the other eye was an opacity on the limbus above. In this left eye was a yellow translucent area, which had gradually become larger, and was now interfering with vision. This patient had suffered from chronic blepharo-conjunctivitis in both eyes.

Sir William Lister considered that the case belonged to the group of "washleather patch" of the cornea. These cases showed a variable amount of infiltration and vascularization. He had examined a sliced-off portion from a case, and it showed a mass of round cells, and a few large ones, like giant cells, but there was nothing very distinctive about the microscopical picture. The condition cleared up in that patient.

Mr. O. G. Morgan spoke of a similar condition he had seen in an adult; there was the same sharply demarcated edge. The patient became blind, the cornea becoming quite opaque. In the other eye practically half the cornea was covered. Somewhat later tuberculin was tried, and from that time the inflammatory reaction began to go, and in the three years since it had not increased at all. Vision was now secured through a $\frac{1}{4}$ sector of the cornea.

Mr. Treacher Collins thought a microscopical examination of a small portion should be made, as he feared epithelioma.

Mr. Hudson said the child was obviously a congenital syphilitic, and conceivably the eye trouble might be related to that disease, perhaps it was an atypical interstitial keratitis. It would be well to give anti-syphilitic treatment.

MR. HUMPHRY NEAME showed a boy aged 17 in whom retrobulbar neuritis had been followed by optic atrophy. In May last he came to hospital complaining of failing vision which had lasted ten days. There was neither pain nor discomfort in moving the eyes. Vision was $\frac{6}{60}$ in each eye. There was 2D. of hypermetropia, and vision was not improved by spheres. There was loss of color perception in the center and upper portion of each field. Sepsis of tonsils was found, and a few weeks after that had been dealt with he was reported to be better. The sinuses and the sella Turcica were pronounced normal on X-ray examination.

MR. MALCOLM HEPBURN thought it possible that this condition was the beginning of disseminated sclerosis.

MR. GRAY CLEGG said that a few days ago he had a case of a similar type. There was some inflammation of the optic nerve head and retina some months ago. That had now subsided, and the man now had a large central scotoma.

MR. MORGAN thought the likelihood of Leber's optic atrophy should be considered, though he could not get a history of a similar condition in other members of the family.

MR. J. H. FISHER said that despite the X-ray findings concerning the sella Turcica, the possibility of this being hypo-pituitarism could not be ruled out. This patient had the characteristic waxy skin, and had no growth of hair on the face; in addition the shape of his skull was uncommon. There might have been some pressure from above on the diaphragma cellæ, producing evidence of hypo-pituitarism and secondary optic visual pathway involvement by that means.

MR. HUDSON showed a sub-conjunctival cyst in a boy aged 4. He regarded it as a scleral cyst, as sclerotic tissue could be seen stretched over the outer part of the cystic swelling. There was no history of injury, such as would lead one to suspect implantation cyst or partial rupture. He would explore it and examine the lining wall. A member suggested he should inject tincture of iodine, but the speaker considered that would be risky. It had become smaller during the past fortnight, and it was possible it might get smaller still.

MISS ROSA FORD showed a case of orbital tumor which was secondary to a breast tumor which was removed. She asked what was likely to be the effect of radium in such a case.

MR. GRAY CLEGG thought the insertion of a tube of radium would prove of considerable service.

MR. R. C. DAVENPORT showed and demonstrated on the screen two cases of so-called congenital macula coloboma in both eyes in mother and son. It was, he said, striking to find the condition in two members of a family. The mother illustrated the flat type of lesion, the son the excavated type. In regard to the ætiology, it was more difficult to explain it in four eyes on an inflammatory basis than on a developmental one. Both these patients had vision $\frac{6}{24}$ binocularly. The mother said that in both her own and her sons cases the condition was noted from birth.

MR. M. HEPBURN objected to the application to these two cases of the term coloboma. "Coloboma," he contended, meant coloboma of the choroid, and if any other situation than the macula was concerned, one saw a gap in the choroid when looking at the sclera. Here there was but little of that proliferation of pigment which characterized true coloboma. He regarded the condition as a definite inflammatory scar, even though it had happened to occur in both mother and son.

THE PRESIDENT said it would be wise to use the word in inverted commas in such cases. The Germans implied that coloboma meant congenital absence of choroid.

MISS IDA MANN said that in the boy, though there was excavation and some failure, one could see many large choroidal vessels all over the floor, and there was no actual absence of choroid. She considered that the tissue seen was scar tissue overlying the choroid.

MR. TREACHER COLLINS supported the idea of the congenital origin of these gaps in the choroid, and told of a case, with the same defect of vision as this boy, who yet was doing quite well at a public school.

THE PRESIDENT mentioned a case of the kind who, despite his restricted vision, took an Agricultural degree. He seemed to have trained the periphery of the retina to carry out the function normally appertaining to the center.

The meeting concluded with an epidiascopic demonstration of drawings illustrating various congenital abnormalities of the optic disc.

REPORT OF THE SECTION ON OPHTHALMOLOGY, NEW YORK ACADEMY OF MEDICINE.

By Dr. THOMAS H. JOHNSON, Secretary.

MEETING OF OCTOBER 27TH, 1927. DR. BERNARD SAMUELS, CHAIRMAN.

Dr. Martin Cohen presented for Dr. E. Török a case of **cyst of the retina.** The patient, a young man aged sixteen years, stated that three and one-half years ago in school both eyes were found normal. One year later the left eye began to fail, for which he was given glasses. On September 20, 1927, the vision of the right eye was $\frac{20}{20}$ and of the left eye $\frac{20}{200}$. The right eye was normal. The left eye showed about 3D. of hyperopia. It was externally normal. The vitreous was clear, with the exception of a few large floating opacities. The disc was normal. There was a sharply-defined cyst-like detachment in the extreme nasal periphery of the fundus, transparent, and at its lower edge showed a crescent-shaped reddish area.

With a plus 12 lens a shiny, glistening, elongated body can be observed in the cyst, which looks like a light reflex. The retina adjoining the cyst, in the lower periphery of the fundus, is detached. The detachment is shallow and extends from the periphery to the outer three-fourths of the eyeball and from above extends downward towards the disc in the form of two or three whitish streaks.

One week later the condition was the same, but one week later the detachment had extended to include the entire fundus. The appearance of the cyst in the nasal periphery was unchanged. I thought the shiny, elongated body seen in the

cyst might be a cysticercus or it might also be a light reflex which moved with the cystic detachment.

DR. HENRY H. TYSON presented a case of **lenticonus posterior** with two drawings made with the slit lamp, which is published in full in this issue.

DISCUSSION: DR. E. J. MARSH. Through the courtesy of Dr. Tyson, I had the opportunity of examining this case last spring, and noted at that time several points of contrast between it and the case which I had the privilege of presenting to this section a year ago. In the first place, while the conus in my case has the form of a perfect hemisphere, in this case it is flatter, like a saucer; otherwise expressed, it is a segment of a sphere of much larger radius. At the same time, it has the same sharply-defined margin, though less truly circular, and not the gradual curve described by Vogt and others. This case also shows a prominent opacity in the adult nuclear and posterior cortical layers, where mine was absolutely clear and normal: in this respect it rather resembles the cases of Vogt and Riedl. In general it may be said to occupy a position intermediate between those cases which have been classed as "lenticonus" and those distinguished by the term "lentiglobus," thus refuting in considerable degree my suggestion that we may have in these two sorts of cases really two different anomalies occurring at the same site, and with certain points of resemblance. This idea, if it ever had any merit, now seems untenable in the pressence of this case of Dr. Tyson's.

This case does not appear to shed any new light on the obscure problem of ætiology. In this connection it is interesting to note that this question has recently been even more confused by Vogt's report of a case with all the characteristics of lenticonus, but in the inferior temporal quadrant of the posterior lens surface, instead of the typical position at the pole. No explanation of this anomaly has been offered, so far as I have been able to learn: it certainly could be more readily associated with the capsular hernia theory than with the hyaloid traction theory of origin. Whether this is true of Dr. Tyson's case also cannot definitely be said, the opacity preventing a very satisfactory study of the posterior lens capsule at the site of the malformation.

DR. ALGERNON B. REESE gave a lantern slide demonstration of microscopic preparations, showing the **lesions of the globe resulting from contusions.**

The first group of cases shown comprised traumatic detachments of the retina, of which there were four types:

1. Those occurring late as a result of the organization of blood along the anterior border layer of the vitreous. The contracture of this fibrous band extending from the ora serrata to the ligamentum hyaloideæ pulls the retina forward.

2. Those occurring late as a result of organization of vitreous hemorrhage.

3. Those occurring early as the result of a rupture of the retina which is often at the ora serrata.

4. Those occurring early as a result of a choroidal or subretinal hemorrhage.

Another group of cases were those of circular hemorrhages extending throughout the course of the ciliary body, thereby relaxing the zonules of the lens and giving the clinical picture of spasm of accommodation.

The mechanism and pathology of direct and indirect ruptures of the globe and various types of subluxation and luxation of the lens, with their varying complications, were demonstrated. The mode of formation and pathology of holes in the macula and retinitis sclopetaria were shown. Also iridodialysis, cyclodialysis, ruptured lens capsule, traumatic keratitis and sequestration of cornea.

The paper of the evening was on **loss of vitreous** by DR. ISAAC HARTSHORNE.

Report of three cases, two intracapsular by the Barraquer-Green method modified by the author and one extraction after capsulotomy, in all of which there was a large loss of vitreous. In the first two after withdrawal of the lens, the wound gaped and at least one-third of the vitreous escaped. The third patient was a squeezer and after capsulotomy on applying pressure vitreous presented, and after extraction the wound gaped and about half of the vitreous was lost. The healing in the first two cases was uneventful and normal vision was obtained. The third case gradually developed a shrunken eyeball, which will be enucleated.

Cases 1 and 2 show that marked loss of vitreous does not

necessarily mean a lost eye, especially if good coaptation between the cornea and sclera are obtained, and provided the eye is left alone long enough to give a chance for firm closure of the wound and for the eyeball to fill with aqueous.

In the presence of marked loss of vitreous, the eye has a greater chance of preservation if the lens has been extracted in capsule than if the posterior capsule was left behind; because: Since vitreous is not replaced, the eyeball must be refilled by some fluid to be preserved and that fluid would naturally be the aqueous. If the posterior capsule is intact, its upper edge will quickly heal in the scar and prevent the aqueous from filling the vitreous cavity, and hence allow the eyeball to collapse because of lack of sufficient contents to hold it. Whereas, if the capsule entire had been removed with the lens, the hyaloid having been ruptured, the aqueous has more opportunity to enter the vitreous cavity and so fill the eyeball to its normal capacity.

DISCUSSION: COL. R. E. WRIGHT (Madras) remarked that apart from the usual causes of vitreous loss during the delivery of the lens one occasionally met with cases where the section gaped and the vitreous presented in the wound or actually escaped subsequent to a perfect delivery with reformation of the fossa patellaris.

In such cases one must consider lesser degrees of choroidal hemorrhage or choroidal engorgement as possible causes. It was difficult for obvious reasons to demonstrate such conditions within a short time of operation and he had seldom actually proved small choroidal detachments ophthalmoscopically under these circumstances. One rather assumed that displacement of vitreous from the posterior segment after a perfect delivery, which tended to readjust itself was of choroidal origin.

DR. KNAPP suggested as a cause for loss of vitreous in the intracapsular extraction unusual adhesions between the posterior capsule of the lens and the so-called hyaloid. He did not believe that the aqueous fills the eye replacing the vitreous.

REPORT ON THE PROGRESS OF OPHTHALMOLOGY.

Abstracts by Drs. A. N. Alling, New Haven; P. G. Doyne, London; and K. Wessely (*Archiv für Augenheilkunde*), Würzburg.

Edited by Matthias Lanckton Foster, M.D., F. A. C. S., New Rochelle, N. Y.

(*Continued from September issue.*)

XII.—THE RETINA AND OPTIC TRACT.

205. Abelsdorff. **An unusual case of optic nerve disease.** *Klin. Monatsbl. f. Augenheilkunde*, March, 1923, p. 403.

206. Addario. **Thrombosis of the retinal arteries as compared with embolism.** *Bolletino d'oculistica*, May, 1922.

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241. TRAQUAIR, H. M. **Acute retrobulbar neuritis affecting the optic tract and chiasm.** *British Journal of Ophthalmology*, September, 1925.

241a. TRONCOSO, MANUEL URIBE. **Retinosis, Retinitis Externa and Choroiditis.** *Amer. Jour. Ophth.*, x., p. 81, 1927.

242. UHTHOFF. **A case of binasal hemianopsia.** *Klin. Monatsbl. f. Augenheilkunde*, January-February, 1923, p. 138.

243. UHTHOFF. **Optic nerve changes in arteriosclerosis.** *Ibid.*, March, 1923, p. 399.

244. UMBER. **Renal diseases.** *Deutsche medizinische Wochenschrift*, 1923.

245. VALUDE and CHANTIER. **Optic neuritis and trephining of the sphenoidal sinus.** *Annales d'oculistique*, clx., 8, p. 649.

246. VALUDE and WERTHEIMER. **A case of amaurosis without ophthalmoscopic lesions. Differential diagnosis between cerebral tumor and epidemic encephalitis.** *Ibid.*, clx., 9, p. 731.

247. WEILL. **Acute retrobulbar neuritis and posterior sinusitis.** *Ibid.*, clx., October, 1923, p. 793.

248. WISSMANN. **Retinitis gravidarum.** *Klinische Wochenschrift*, 1923, p. 2006.

249. WRIGHT and BARNARD. **The importance of radiography in doubtful cases of optic atrophy with special reference to pituitary disease.** *British Journal of Ophthalmology*, March, 1923.

ABELSDORFF'S (205, **An unusual case of optic nerve disease**) patient had been blinded nine years before by optochin given in the treatment of pneumonia. When she came under observation her vision was $\frac{6}{10}$ and $\frac{6}{18}$, with typical hemeralopia, paracentral scotomata, and impaired color perception, especially for blue. The papillæ were pale, there were degenerative changes in the retina, and sclerosis of the choroidal vessels, the two eyes affected in different degrees. The harmful action of optochin is different from that of quinine and affects both the optic nerve and the retina.

BUCHANAN (208, **Monocular optic neuritis**) has observed an optic neuritis in one eye only in four cases, all in young

women or girls. All had been exposed for a short time to an intense current of air, and one had been hit in the eye by a snowball also. In each case there was only a marked papillitis, with no disturbances of the ocular muscles and no demonstrable diseases of the accessory sinuses or of the internal organs. The trouble cleared up leaving no trace. The author thinks it noteworthy that up to the present time this trouble has been observed exclusively in young women.

LAVAT (230, **Unilateral optic atrophy and retinal arteritis in the course of malaria**) reports the case of a man 43 years old who spent eighteen months at the Dardanelles during the war and had his first typical attack in February, 1917, two months after his return home and discontinuance of quinine. During the next year he developed Addison's disease. In September, 1920, the sight of his right eye failed coincidently with an attack of polyneuritis in his left leg, after he had had no attack for a year. Almost daily the patient observed an obscuration of his right eye, which was regularly relieved by aspirin until March, 1921, when the aspirin failed to do the work and the vision fell to $\frac{1}{10}$. After eight months the eye was totally blind. The pupils were of equal size, the right reacted consensually, but not directly to light. Convergence was normal. The optic nerve presented an atrophy similar to that of tabes, the arteries were as thin as threads and could be followed but short distances. The blood pressure of the retinal arteries was higher than that of the retinal arteries in the sound eye; the general blood pressure was normal. Syphilis was excluded. The tension of both eyes was somewhat subnormal. As glaucoma, chorioretinitis, retinitis, infection or intoxication of any kind whatever, and embolism were excluded, the writer concludes that the cause of the ocular trouble was the chronic malaria, which had at the same time injured the suprarenal capsules and the nervous system. This, he thinks, brought about a chronic endarteritis of the central artery which predisposed to thrombosis and probably obliteration of the capillaries.

DARRIEUX (213, **Choked disk with serous meningitis and an endocrinal syndrome**) found in a man 49 years old who had remarkably large hands and feet, somewhat more weakly developed musculature on the right side of the body than on

the left, and a scoliosis, atrophy of the optic nerve of the right eye, the sight of which had been lost since the patient was twelve years old, and a typical choked disk with greatly dilated and tortuous veins in the left eye. The vision was 0.7. Lumbar puncture caused the choked disk to disappear within twenty-four hours. Nine days later it had returned. After a second lumbar puncture the swelling of the papilla slowly decreased until it disappeared again at the end of fifty days. The blood and the cerebrospinal fluid appeared to be perfectly normal. Darrieux imagines the following to have been the course of the disease: A meningitis with increased intracranial pressure in youth, cause unknown, but probably tuberculosis or syphilis; this produced dilatation of the left ventricle which involved the right optic nerve and at the same time induced by pressure a disturbance in the function of the pituitary gland and of any other related glands with internal secretion. The present affection is the outcome of the same process.

Stock (238, **Retrobulbar neuritis**) has observed thirteen cases of retrobulbar neuritis in the past eighteen months. The causes were in one case intoxication with alcohol, in two certainly and in four probably multiple sclerosis, in one grave tuberculosis, in one empyema of the antrum of Highmore, and in four unknown. Ten cases were treated with small doses of salvarsan with good results, and he recommends this treatment as simple and efficient, especially in cases of probable multiple sclerosis.

Roenne has pointed out that the familiar condition of acute retrobulbar neuritis may have its site in the chiasm or tract. The onset and course of the disease are similar to those in which the lesion is in the optic nerve. Headache and field changes, the latter characterized by the association of hemianopic defects with central scotoma, are the chief features. The field defects tend to wander over the field, recurring in one place and appearing in another. Papillœdema is often present, but Roenne believes it is not directly connected with the diseased area, or concerned with the functional defect.

Francis and Koenig (214a, **Retrobulbar neuritis in diabetes**), regard the lesion arising in the course of diabetes as due

to endogenous toxin or toxins liberated during the disease, which seem to exercise a selective action on the papillomacular bundle of the optic nerve. The ketone bodies and the acetone content of the urine may be the index of the toxin in the circulation for they are present during the amblyopia and disappear with the visual improvement. The condition comes on most frequently in middle age.

YUDKIN.

TRAQUAIR (241, **Acute retrobulbar neuritis affecting the optic tract and chiasm**) describes in detail four cases the features of which correspond closely to those described by ROENNE. All four cases occurred in females between the ages of twenty and forty. No disease of the central nervous system was discovered at the time, or has as yet appeared, in any of the four patients, though they have not all been watched for very long. Two of the cases complained of bilious headaches.

The field changes were characterized by marked central defects and relating to the peripheral disturbance, no marked swelling of the optic papilla was seen in any of the cases though two cases showed pallor of the disc. Trachair emphasizes that the least affected eye may be so slightly affected that it is passed as normal, the diagnosis thus becoming faulty. He emphasizes the importance, in cases of apparent unilateral retrobulbar neuritis, of carefully examining the central field of the apparently sound eye. When the true site of the lesion is established, the diagnosis consists in excluding other causes of interference in this part of the visual path. Tumors usually show progressive increase in the symptoms and increasing improvement of the peripheral field. In localized syphilitic basal meningitis bitemporal hemianopia with headache may be the only symptoms but the field changes are grosser.

To distinguish from a supra-geniculate lesion when the field defects are homonymous, incongruity in the character of the field defects will help, as it is unusual in supra-geniculate lesions for central field defects of a variable nature to occur.

The immediate prognosis is good but the possibility of the development of nervous diseases later should be kept in mind.

P. G. DOYNE.

From experimental work on dogs, DAVIS (213a, **The influence of decompression operation as experimentally produced papilledema**) finds that subtemporal decompression prevents papilledema produced by the introduction of agar in gelatine capsules in the cerebellum or cerebrum. Such a cranial opening is as efficient in the presence of a cerebellar tumor as is a suboccipital craniotomy. This work also corroborates the importance of the mechanical factor of an increase in intracranial pressure in the production of papilledema. YUDKIN.

VALUDE and CHANTIER (245, **Optic neuritis and trephining of the sphenoidal sinus**) report a case of severe optic neuritis which was cured by the opening of the sphenoidal sinus, although no pathological changes had been detected in this except for a slight dilatation. The Wassermann reaction was negative. The ordinary methods of treatment had failed completely. The operation was performed four and a half months after the beginning of the disease. During the days immediately following, the persistent headache ceased, and the vision, which had fallen from 1.0 to counting fingers at 25*cm*, began to improve and within four weeks had risen to its normal.

WEILL (247, **Acute retrobulbar neuritis and posterior sinusitis**) recommends operative intervention on the accessory sinuses only when there is positive evidence of the presence of posterior sinusitis, as in his experience this disease recovers just as quickly without as with such an operation in the other cases. He bases his opinion upon twenty-five cases, of which sixty-eight per cent. were due to multiple sclerosis, while a part of the remainder had an atypical course and in part tumors were demonstrable.

Cerebral aneurysm appears to be more common than is usually supposed. Nearly half of the reported cases died suddenly from an apoplectic form of seizure without any preceding symptoms. It appears to be quite frequent in youth. The only possible significance in the condition is the occasional intermittent character of such symptoms as there may be. CONWAY (209a, **Cerebral aneurysm causing ocular symptoms**) reports two cases.

The first case, a young man aged 23, was first seen in May,

1923. His symptoms consisted in vague pains in the head, which were increased by exertion, and failure of vision. On examination at that time the right pupil was larger than the left, reflex normal, but with a tendency to hippus, and there was pallor of the discs. Vision was reduced to figures at 6 feet and the visual fields showed a bitemporal hemianopsia. He was thought, at that time, to be, in all probability, a case of pituitary tumor. General examination revealed nothing material. X-ray showed expansion of the Sella Turcica. Following upon this he became rapidly blind, but after a short time vision returned and he was discharged a month later. The visual fields gradually cleared up, leaving a few relative and absolute scotomata (charts are shown in the article) in both fields. He remained well for the next 6 months, except for pains in the head. In January, 1924, he suddenly became unconscious and died in 2 hours. An aneurysm was found attached to middle cerebral artery on its median and upper aspect.

The second case was a woman, aged 40, who was admitted to the hospital with pains in the back of the neck, headache and dizziness and defective vision. The pains had been present, on and off, for 2 years, but the defective vision was only of 2 weeks' duration. Soon after admission she became stuporous, and there was right facial palsy, paresis of left arm and leg. The right pupil was larger than the left. Pupil reactions were at first normal, but afterwards unobtainable, and there was double optic neuritis. There were red blood corpuscles in the cerebro-spinal fluid. She died a month after admission to hospital, and an aneurysm of the left vertebral artery arising just within the cranium and invading the cerebellum was found. DOYNE.

BANTIN (206a, **Diabetic lipæmia retinalis and fat embolism**) reports a case in which fat globules were seen in the retinal veins. The patient was extremely ill with a concurrent condition of pneumonia and nephritis. Recovery from the acute diabetic symptoms was fairly prompt. The complications also gradually disappeared under controlled insulin treatment. YUDKIN.

By means of a Gullstrand binocular ophthalmoscope and red free light VON DER HEYDT (223a, **The interpretation of retinal**

folds) has observed folds in the retina. These were found in cases of retinal separation, and in cases of edema of the retina where the internal limitating membrane was frequently separated from the nerve fiber layer by fluid. The direction of folds was determined by the points of retinal fixation. Those radiating from the macula involve the limitans interna only.

YUDKIN.

TRONCOSO (241a, **Retinosis, retinitis externa and choroiditis**) classified the pathological changes in the retina and choroid according to whether the process was an inflammatory or degenerative one. As the majority of the diseases of the internal layers were not inflammatory, but degenerative, he proposed to call them "retinosis." The group commonly designated as "chorio-retinitis" he divided into (1) diseases of the external layers (external retinosis), and (2) choroiditis. This distinction was clearly marked in the first stages of these conditions, but later the two membranes became adherent and the process was a chorio-retinitis. The pigment epithelium reacted to injury by becoming atrophied, completely absorbed or proliferated to external layer.

YUDKIN.

TOOKER (240, **Bilateral papillitis associated with accessory nasal sinus disease and nephritis**) reports a case with diplopia and loss of vision which showed some cerebral and renal vascular symptoms. The ocular and cerebral manifestations disappeared when the infected ethmoid and sphenoid sinuses were exenterated, but the albuminuria and hypertension remained after the removal of the source of infection. ALLING.

(To be continued.)

ABSTRACTS.

The Nature of Intra-Ocular Fluids, by W. S. DUKE-ELDER. Monograph Supplement III—*British Journal of Ophthalmology*, 1927.

Duke-Elder's monograph of 113 pages, with over 500 references from the literature, deserves a careful reading by every thoughtful ophthalmologist, because no abstract can do it justice, and especially because it affords the point of view necessary for an understanding of the advances which are being made in ophthalmology. Reflecting the data and views of a large number of contemporaries who have been applying the methods of physical and colloidal chemistry to the study of eye problems, the author devotes the first half of his monograph to a discussion of fact-seeking experiments designed to clarify the bio-physical conception of fluid exchange within the eye, and he devotes the second half of the monograph to theories concerning the elaboration and the movements of the aqueous humor.

I. EXPERIMENTAL.

With respect to the chemical constituents of the normal aqueous humor of the horse and rabbit, Duke-Elder shows that aqueous contains substances identical with those of blood serum, differing only in concentration. Thus, the serum contains *colloids* (proteins, "fats," immune bodies and ferments) greatly in excess over identical bodies in the aqueous, the ratio being roughly as 400 to 1. The serum contains *non-dissociated diffusible* substances (sugar, urea) in concentration similar to that of the aqueous, the ratio being as 1 to 1. The sugar content of arterial blood plasma averages .158 grams per 100*cc*, and that of venous blood plasma .133 grams per 100*cc*. The sugar content of the aqueous averages .151 grams

per 100*cc*, and therefore it may be considered as falling within the range of capillary blood. Of ***dissociated diffusible*** substances (electrolytes), the serum contains ***more cations*** (sodium, potassium, calcium, and magnesium) than does the aqueous, the ratio for sodium being 145 to 121, and at the same time the serum contains ***less anions*** (Cl, PO_4, SO_4) than does the aqueous, the ratio for chlorine being 103 to 123. Consequently, from its excess of negative radicles, aqueous shows a higher alkalinity (pH 7.5 to 7.7) than does the blood (pH 7.28 to 7.41).

In studying the chemical composition of the ***abnormal aqueous humor***, re-formed 20 minutes after paracentesis, Duke-Elder found an increase in the colloids present, a nearly unchanged glucose content, and a diminished concentration of anions (chloride), and he proposes the designation "plasmoid aqueous" to express the shift toward the chemical nature of the plasma. He states that a "plasmoid aqueous" results under all conditions where the ocular capillary walls are dilated, such as following paracentesis, radiation of the eye, application of heat, irritant subconjunctival injections, mechanical or chemical stimulation of the cornea, and venous congestion. He claims that, under similar circumstances, any agent which will prevent the dilation of ocular capillaries will prevent the formation of "plasmoid aqueous."

Comparing the physical properties of the "plasmoid aqueous" with those of the normal aqueous, with respect to specific gravity, refractive index, surface tension, viscosity, conductivity, and osmotic pressure, Duke-Elder shows that changes occur which would be expected with an increase in the colloids and a decrease in the anions. Using a micro-osmometer, he ascertained that the plasma has a higher osmotic pressure than does the normal aqueous, by 20 millimeters of mercury in the rabbit, and by 30 millimeters of mercury in the cat and dog.

With an ingenious method for studying blood pressure, utilizing a micro-cannula delivering dye-charged solution and observed through a microscope, Duke-Elder demonstrated that the pressure in the veins leaving the eye is normally from 1 to 2 millimeters of mercury higher than the intraocular pressure, measured simultaneously.

II. THEORETICAL.

Armed with these facts, Duke-Elder states his belief:

"that the nature of the mechanism of the formation and circulation of the aqueous humor as at present classically accepted and taught is wrong;

"that the aqueous is neither a secretion, nor in the accepted sense, a transudate from the blood;

"that it is a dialysate from the capillary plasma, the essential dialysing membrane being the capillary walls;

"that under normal conditions, while an interchange due to metabolic activity constantly occurs, and an internal thermal current exists, the aqueous humor does not circulate actively through the eye, but it is in equilibrium with capillary blood;

"that at the same time, constantly occurring changes of pressure, induced by muscular movements, etc., superimpose upon it secondarily a minimal and intermittent circulation."

Duke-Elder points out the insufficient evidence to support the secretory theory of aqueous production, and the serious difficulties in which the time-honored teaching of Leber finds itself to account for the unequal partition of cations and anions between plasma and aqueous, to explain the outflow of aqueous against the higher pressure of the exit veins, and to ignore the difference in colloidal osmotic pressure which has been ascertained to exist between serum and aqueous.

On the other hand, he clearly formulates the theory of dialysation, which appears to be consistent with the facts ascertained, and which is dependent upon the semi-permeability of the ocular capillary walls, almost impermeable normally to the colloids of the blood, but freely permeable to the diffusible substances of the blood. He attempts to show that the counterpoised forces operating within the capillaries match each other, the osmotic pressure of the blood colloids and the blood pressure within the capillaries. He adduces evidence to show that the aqueous humour is in osmotic chemical and physical equilibrium with the capillary blood, in the normal and in the abnormal eye. He invokes

Donnan's Theory of Membrane Equilibrium to explain the unequal partition of ions between plasma and aqueous. If one is willing to concede that the aqueous is in perpetual equilibrium with the capillary blood, one can scarcely avoid the belief with Duke-Elder that the aqueous is essentially stagnant, except for those currents secondary to convection, to muscular contractions, and the pulse beat.

It is not difficult for one to follow Duke-Elder's convincing argument concerning the formation of the aqueous as a dialysate from the capillary blood, but it is difficult to concede the essential stagnation of the aqueous. One would like first to know more about the anatomy and physiology of the capillaries of the uveal tract. Are the capillaries of the ciliary body and those of the iris strung, tandem fashion, along the same vessel line? Do these capillaries have the same blood pressure, and do they contain blood having identical osmotic values? Is the osmotic, chemical, and physical equilibrium between blood and aqueous constantly attained, or merely always approached? These questions, and many others, are of course for the future.

The work of Hamburger, Weiss, Magitot, Baurmann, Dieter, Serr, and the comprehensive work of Duke-Elder mark the beginning of a new epoch in ophthalmology, one which will be of great interest, and let us hope one of greater information.

J. Herbert Waite.

BOOK REVIEWS.

I.—An Introduction to Clinical Perimetry, by H. M. TRAQUAIR, M.D., F.R.C.S., Ed. With 164 Illustrations and a Colored Plate; 258 pages; published by the C. V. Mosby Company, 3523 Pine Boulevard, St. Louis, 1927; price $13.50.

Easily familiar with the subject to which he has so often admirably contributed, gifted with the power to say much in a few words, judicious in his selections from the literature and in their analysis, able in the clarification of specialized knowledge, Dr. Traquair has produced a book of distinguished merit.

The book is divided into three parts and an appendix. In Part I the reader is introduced to the author's interesting comparison of the field of vision to a hill or island surrounded by a sea of blindness. Three chapters are devoted to a clear description of the normal field regarded as consisting of a central area, an intermediate and a peripheral zone, of the various perimetric instruments, and of the methods of examination. The value in visual field studies of the simplest non-mechanical instruments is properly and definitely emphasized.

An early advocate of quantitative perimetry, and an important contributor to this subject, Traquair demonstrates that the visual field must not be charted with test-objects of one size only, but with a series of objects of graduated sizes, and that "each test-object and its distance from the eye should be carefully selected with a view to the requirements of the individual case, and should be recorded." He believes we shall obtain a better understanding of the field of vision if we think of it "as a hill whose surface sinks and rises," and not as "an area whose extent contracts and expands." Naturally, the defects should be regarded as "depressions," and not as "contractions."

The chapters which pertain to the visual field anomalies caused by disease of the choroid and retina by glaucoma, by pathological conditions resident in the optic nerve and in the suprachiasmal pathway are admirable, and are illustrated by instructive charts from the author's large collection.

With especial satisfaction, the reader follows the author's well illustrated elucidation of the field defects with respect to the toxic amblyopias, glaucoma, and lesions in the geniculo-calcarine pathway.

Although illumination in field-testing is not neglected, it deserves a larger share of attention than it has received.

Dr. Traquair evidently, to quote Sir William Osler, belongs to those "men of science who pay homage . . . to the god of words whose magic power is nowhere so manifest as in the plastic language of Greece," in that he has introduced the term "plerocephalic edema," to indicate an edema of the disk due to increased intracranial tension, and thus distinguishes it from a disk-edema dependent upon some other cause, for instance, a local optic nerve disease. It will be interesting to observe whether this term secures a permanent place in neuro-ophthalmological literature.

A brief chapter is devoted to the functional changes in the field of vision which at one period were credited with a significance which they did not deserve, largely because the influence of suggestion was not appreciated. Properly, the perimetrist is urged to make himself familiar with these types of field defects which have so often been, and still are, mistaken for "genuine evidence of the presence of organic lesions."

In an appendix to the book among other subjects—the anatomical relations of the visual paths, the blood supply of the visual nerve paths, the uses of the perimeter otherwise than in field-testing are discussed.

Perimetry is an art and a science. Year by year its increasing importance in ophthalmological and neurological investigation has been recognized. It has taken a front rank among the methods of precision.

Dr. Traquair's book, modestly entitled "An Introduction to Clinical Perimetry," wherein he has condensed the result of his own wide experience, as well as that of colleagues here and

abroad, working along the same lines, is a valuable addition to the literature of this subject and richly deserves unqualified approval.

G. E. de SCHWEINITZ.

II.—**Atlas of the Pathology of the Eye,** Part II, by DR. ADALBERT FUCHS, Vienna. Published by F. Deuticke, Leipzig und Wien, 1927; price $12.00.

Dr. Fuchs' well-known *Atlas of the Pathology of the Eye* has now been enlarged by the addition of a second part. This consists of thirty-two plates, with one hundred and seven figures beautifully executed in color, showing the histology of a variety of pathological conditions.

Diseases of the lids, conjunctiva, lacrimal organs, orbit and fundus are all dealt with, and attention is paid to some complications of the cataract operation and the after-results of injuries.

The text (the English translation is an improvement on that of the first volume) accompanying the plates makes frequent mention of the clinical findings of the cases depicted, and aims to correlate these with the anatomical findings. In this respect, as well as in not being over-technical, the Atlas is well adapted to the needs of the practising oculist.

O. P. PERKINS.

The first part of this Atlas published in 1924 established a standard for this work which has been continued in the second part with consistent credit to the author. The first part had to do with the diseases of the lids, the conjunctiva, the lacrimal apparatus, the orbit and the optic nerve, while the second part amplifies these conditions as well as delineates conditions of the fundus, and in addition gives the histopathology of the sequelæ of injuries of the anterior and posterior portions of the eye. The text and illustrations of the first part unquestionably occupy an outstanding position in books of this character, but there are works on these subjects sufficiently ample for the ordinary student. It is therefore to our way of thinking, in the second part, especially that part showing the ultimate development of the sequels of ocular traumatism, that the work shows its greatest value. There

is also a good feature in the book not to be found elsewhere, namely the disposition to describe and illustrate in such a manner as to correlate the data obtained in the living eye by the more modern instruments of precision, especially the slit-lamp. In addition to the value of the subject-matter of the book, one cannot help but be impressed with the elegance of the slides selected for illustration, and the artistic excellence with which they have been drawn and reproduced. Doctor Fuchs is to be complimented in having assembled so much valuable material in such a small space without depriving any of it of the prominence which it deserves. This is a most creditable undertaking and the work should be received by those interested in this subject with great enthusiasm.

L. WEBSTER FOX.

III.—**Acta Ophthalmologica,** Vol. V, Fasc. 1–3. Aug. 20, 1927. Fasciculus Gratulatorius in Honorem K.K.K. Lundsgaard. Dedicaverunt Amici et Ophthalmologicæ Artis Collegæ Civitatum Quattuor Septenrionalium.

This complimentary volume dedicated to Professor Lundsgaard, the Swedish ophthalmologist, on the occasion of his sixtieth birthday by his friends and colleagues, contains a group of important papers in English, French and German. For instance, Gunnar Ahlgren reports the results of elaborate research work on the oxidation mechanism of the crystalline lens performed in the physiological laboratory of the Royal University of Lund, Sweden. Another especially interesting paper is that by Chr. F. Bentzen, concerning the general light bath treatment of some diseases of the eye. His general thought is that light has no specific action on ocular disease—and that the benefit derived is dependent upon the favorable influence light baths have on the general health. Clinically the best results were obtained in cases of tubercular iridocyclitis. The relationship between diseases of the teeth and the eyes is well reviewed by O. Bjerrum of Copenhagen. High myopia and its prognosis is treated by Olaf Blegvad and the conclusions drawn reflect the experience in Copenhagen. This is illustrated by charts and diagrams. An unusual form of nasal hemianopsia is discussed by Viggo Christiansen. Erythropia and xanthopsia in hemeralopia is studied by

Carsten Edmund. Not the least of these valuable papers is that by Holgar Ehlers concerning the experimental researches on corneal vessels, which, although it had been read at the Oxford Ophthalmological Congress in 1927, is entitled to considerable attention, since the results obtained in this investigation will go far towards clarifying our appreciation of certain affections involving the cornea. It is impossible to review all of the able papers, but the volume, it may be said, sets a very high standard. Our felicitations are at the disposal of the editor, and our congratulations are the portion of the learned Professor Lundsgaard. We share with his colleagues that high feeling of esteem and respect he has enjoyed through all these passing years. Vale!

L. WEBSTER FOX.